SCIENTIFIC AMERICAN

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THE MANUFACTURE OF DRAIN PIPE.

The manufacture of drain pipes is similar in many respects to that of bricks and tiles. It depends little upon manipulative skill, but much upon the thorough intermixing of the material used and the freedom of the same from impurities. The clay used in this vicinity is a refractory potter's or plastic clay containing lime and magnesia, with more or less oxide of iron, either black or red. It comes from the large beds existing near Woodbridge, N. J., and belongs to the series of upper secondary rocks underlying the green sand deposits.

The first process which the material undergoes is tempering with water and mixing in pug mills in which are spirally disposed blades, which cut up the mass and at the same time move it forward. It passes through two mills, one horizontal and the other vertical, and is then transported to the press. Before it is placed in the latter it is wired, that is, taking a good sized lump, a workman cuts it through repeatedly with a wire, and in this way removes all large nodules of iron pyrites, stones, and similar foreign substances. Iron in the clay is the chief difficulty with which potters of every grade have to contend. It obtrudes itself in microscopic specks in fine kaolin, and in lumps as big as an egg in the coarse drain pipe material. In fine porcelain it produces black spots, which at once reduce the goods to inferior quality, while in drain pipe it melts, runs, and leaves holes. To extract even the large masses by wiring by hand seems at the present time, when processes infinitely more delicate and complicated are done by machinery, rather behind the age; but we were informed that no other means answers the purpose so well. The clay is tempered so stiff that it is practically impossible to force it through sieves or grating without breaking the latter away, nor does there, for the same reason, seem any apparent way whereby magnets could be advantageously used to extract the iron.

After being wired the plastic mass is placed in the press, Fig. 1. This consists of a receiving cylinder in which is a follower driven down by the large steam cylinder above. Through the lower cylinder runs a spindle which supports at its lower end a core. At the bottom of the cylinder are adjustable dies, between which and the core the clay is forced, emerging, as in the case of the lead in lead pipe manufacture, in tubular form. Before pressing begins, however, a wooden drum is placed upon a platform which may be screwed up and down, and which is located on the bed block of the press. Sliding on this drum is a core or mould of the exact shape and size of the inside of the enlargement or collar of the pipe. This mould, when the pressing first begins, is brought up close under the cylinder and a pair of collar dies are brought around it. The annular space between these dies and the core is closed beneath, so that when the clay is forced it cannot descend, but must fill said annular space. This done, the collar dies are opened and the pressing is continued, the pipe of uniform diameter thus produced sliding gradually down over the drum, as represented in the illustration.

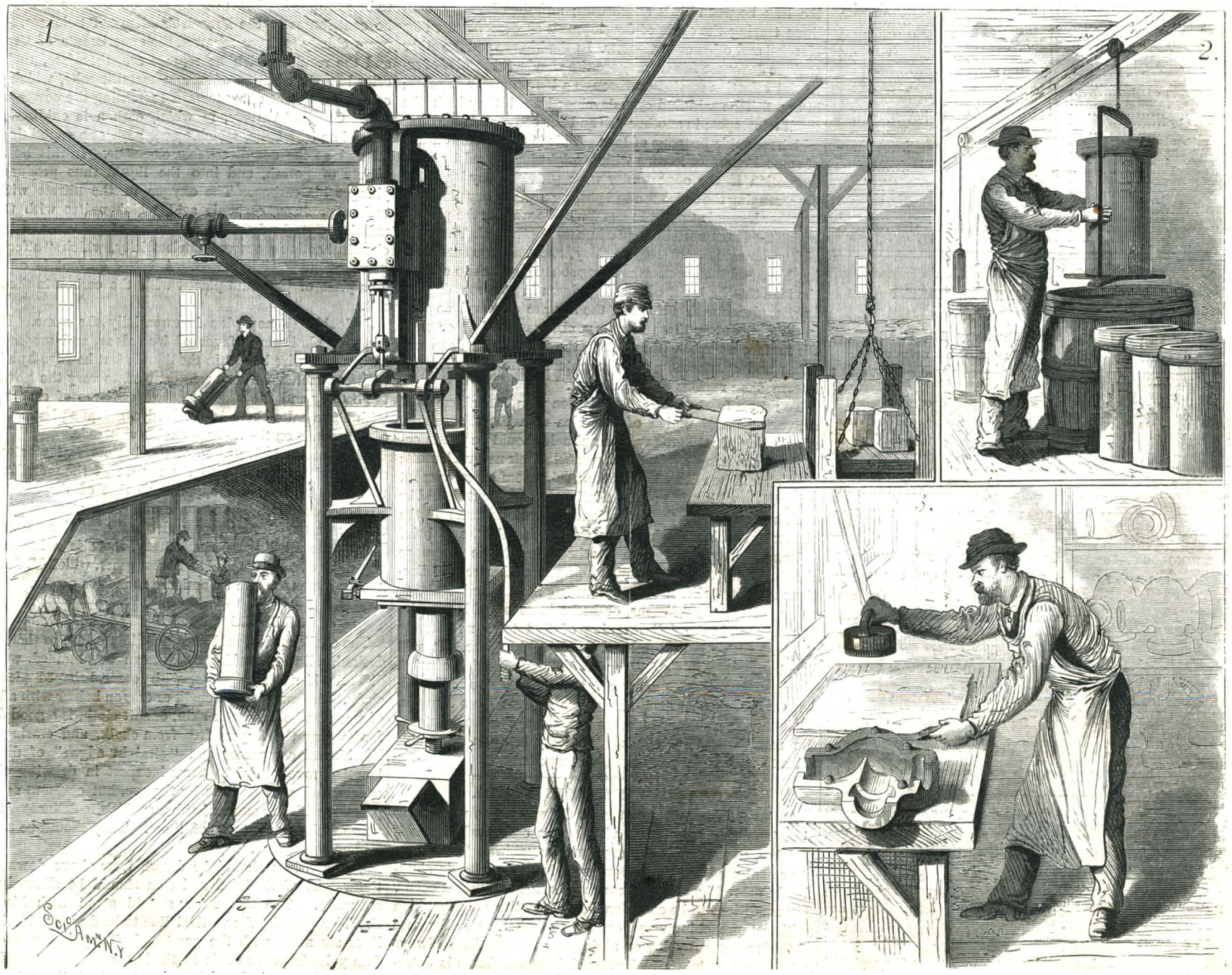
If, however, the pipe is to be curved instead of straight, the guide drum below is not used; but as soon as the collar is formed, the attendant grasps the pipe as it comes out and bends it to the desired curve by hand. As soon as each section of pipe is thus finished, it is removed and placed upon a rack until thoroughly dry.

The glaze used is ordinary slip with no coloring matter, the clay employed being of such a nature that it will melt without running by the time the material of which the pipe is composed is burned to a body. Dipping in the glazing is done in the case of large pipe by the simple means shown in Fig. 2. The pipe rests on a counterweighted suspended platform, which is easily raised or lowered by hand into or out of the mixture. In making traps and odd shapes from the plastic mass, no press is used, but the clay, cut into slabs, is first hammered into compact condition by hand and then packed in moulds, as shown in Fig. 3.

Baking is done in the ordinary way in kilns. No seggars are used, and the pipes are disposed in nests, that is, inside of a 12 inch pipe there is usually placed an 8 inch, and inside of that again a 4 inch. The heat is kept up for from 54 to 56 hours, when the glaze turns to a dark brownish, glossy hue, and the work is done.

The New Minneapolis Suspension Bridge.

The new suspension bridge in Minneapolis was completed in 1877, under direction of T. M. Griffith. The span is 675 feet; towers, 111 feet high; roadway, 20 feet wide; foot walks, each 6 feet wide; platform, 40 feet above ordinary stage of water. The cables for the main bridge are 9½ inches in diameter, those for the foot walks 4 inches in diameter. The strength of the cables is 10,996,000 pounds, strength of floor stays, 440,000 pounds. The anchorage extends through limestone rock 10 feet thick. An additional protection is made by heavy masonry around each of the four anchors. Cost of the bridge and approaches, about $200,000. Minneapolis was surveyed in 1854. Population in 1870, 18,000; in 1877, 40,000. Capacity of water power, 124,000 horse power. There are 21 flouring mills in the city, manufacturing 1,306,000 barrels of flour annually. There are 20 sawmills, producing 200,000,000 feet of lumber annually. The industries of the city are numerous. Among the many are shingle and lath mills, machine shops, foundries, car shops, woolen mills, paper mills, oil mills, plow, harvester, and agricultural works, planing mills, barrel factories, etc., etc. Annual product of manufactories, about $17,000,000. The city contains 52 churches, 10 large public school buildings, State university, and numerous seminaries and private schools.



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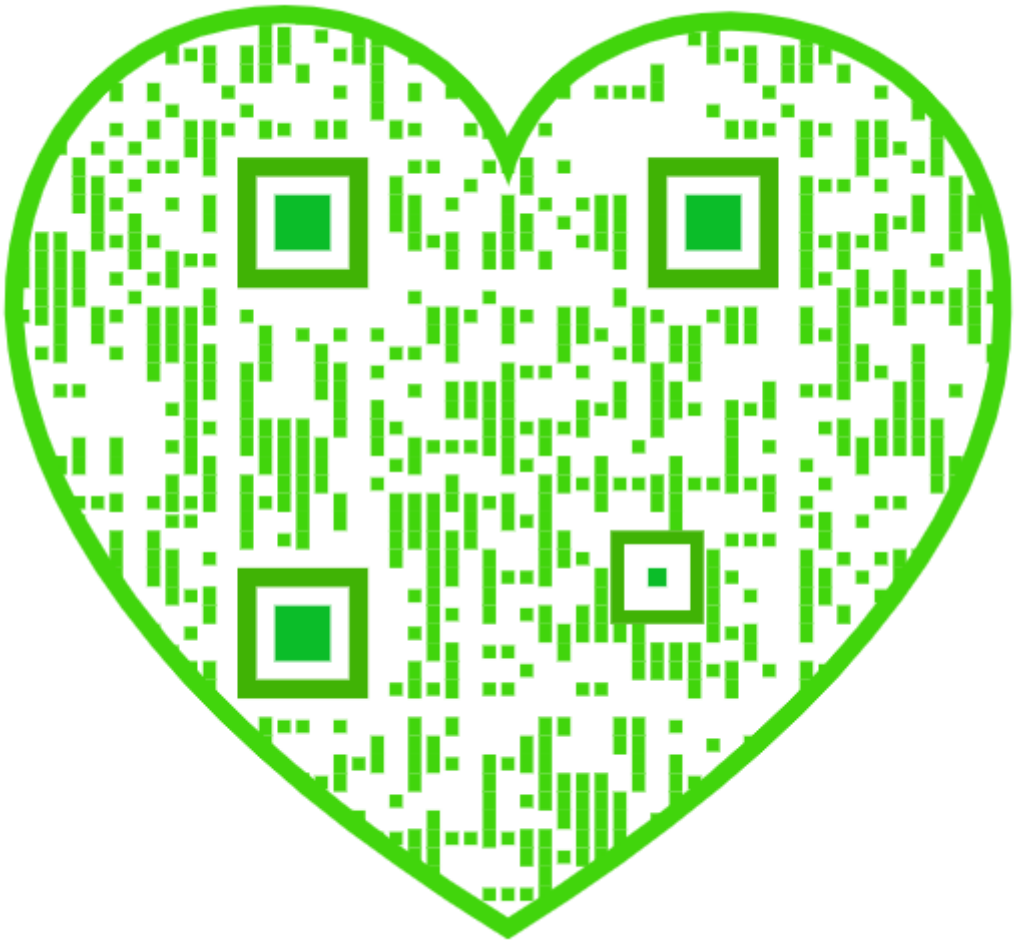

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NATURAL HISTORY COLLECTIONS AS EDUCATORS.

The project of establishing a Zoölogical Garden in Central Park, in this city, on the model of that in Regent's Park, in London, England, is again being brought forward. A number of wealthy citizens have formed a Zoölogical Society and propose to start with a capital of over $100,000. The designated ground is a tract of 20 acres on the west side of the park, just above 96th street and near the new Natural History Building. The society will enclose the site, erect buildings, etc., and charge a small admission fee except on one free day per week.

The collection of living animals already in the park is now very meagre. Lack of funds at the disposal of the authorities have prevented its enlargement or even the erection of suitable edifices for its reception, and in fact, as the President of the Park Commission expresses it, the city keeps "a kind of hotel for menagerie animals," which belong to shows and circuses, and for which care and housing are provided, the owners paying only for food. The condition of these unfortunate brutes has of late been pitiable, and has elicited no small share of the attention of Mr. Bergh and his humane society. The public however continue to manifest great interest in the collection, and to this fact, coupled probably with the recent opening of the new Museum of Natural History, may be ascribed the renewing of the enterprise above noted.

It is perfectly obvious, we think, that collections of natural history specimens, whether the same be of living animals or of fossil remains, are valuable only in an educational regard; and if the same are intended for popular edification, then, unless they are so arranged as to carry the proper scientific instruction to unscientific intellects, they do not fulfill their purposes. This is a simple and very necessary requirement, yet it appears to be systematically neglected, with the result of substituting merely the transitory interest felt in looking at strange objects for the permanent one which might be aroused if their inter-connection and intrinsic peculiarities were more clearly set forth. The Aquarium, for example, in this city, established a year ago, contains a really remarkable collection of marine creatures and it is especially rich in curious connecting links. The visitor may begin with the animated plants, the zoöphytes, trace the development up to the tubellaria and gliding worms, and so on, through the eels and similar types to the true fish. Still advancing, he may find in the green maray perhaps the closest link between the fish and the serpent; in the proteus, the menopome and the axolotl, the links between the gill-breathing and the air-breathing animal; in the seals and sea lions the links between the warm-blooded land creatures and the cold-blooded inhabitants of the sea; in the flying foxes the link between birds and brutes; and thus he may continue tracing the chain of development as demonstrated by Haeckel and other evolutionists. In the kingyo and the other curious Japanese fish he may see the wonderful results of artificial selection carried on through a long number of years; in one fish he will find eyes developed until they look like small telescopes; in another tail and fins converted into films which resemble festoons of lace. This is the merest outline of some important lessons which might be learned by mere inspection if the opportunity were provided say by suitably arranging the collection and posting explanatory placards. Another lesson is taught in an admirable way by the plan on which the famous Berlin Aquarium is constructed. There the visitor descends from story to story, tanks always surrounding him, and the accessories being so arranged as to convey the idea that he is actually going down in the sea depths. In accordance with this plan, the fish are disposed so that in the upper story those creatures always found at or near the surface are met with, while in the lowest, the deep sea fishes and crustaceans are encountered, those dwelling in intermediate regions being between.

To return to the Zoölogical Garden plan, the above will convey a general notion of our idea of what the project should be. That is to say, the animals should be put in enclosures imitating as closely as possible their natural haunts; they should be allowed the utmost freedom of movement compatible with safety; their relative arrangement should be such as to indicate their relationships and descents in the clearest possible manner to the average intellect, and brief information regarding each specimen in simple language should be placed conspicuously upon its enclosure. Collections of fossils, shells, insects, stuffed animals, minerals, or other geological specimens, or herbariums should likewise be exhibited in the full meaning of that term, not merely ticketed with a Latin label and put in a glass case. It will require considerable ability and a full apprehension of what interests the public to carry out the ideas above indicated; but we believe that such naturalists as Professors Agassiz, Bickmore, Marsh, or Morse are fully equal to the task, and the result would be a Natural History Museum creditable alike to its founders and to the metropolis.

PREVENTING COLLISIONS AT SEA.

An invention of some sort is needed whereby a vessel may signal to other ships in her vicinity the course which she is steering, so that collisions may thus be avoided. The means at present used to this end are very inadequate, as is abundantly proved by the frequency with which collisions occur. The conditions to be considered are, first, those under which neither approaching vessel can see the other, as in the case of thick weather by day or night, and second, those always existing after nightfall when a ship's whereabouts is determined by the position of her lights. It will be evident that an invention of the kind needed must combine some sounding apparatus for fogs and some new method of signalling by lights for ordinary night use.

At the present time, sailing ships under way at night carry a green light on the starboard and a red light on the port side. These lanterns are so arranged as to throw their illumination over an arc of 90° to the fore and aft axis of the vessel. Steamers carry in addition a white mast head light. By the relative position of these lights the pilot of an approaching vessel determines which way to steer. If for example he sees a red light only, he knows the other vessel is crossing his bows and moving from right to left, if a green light she is moving in the opposite direction, if both lights are visible she is coming directly bows on. This however is very inaccurate, for the moment the coming vessel steers at a slight angle from direct approach, then one or the other of her side lights immediately becomes invisible. The approaching helmsman, then, has no way of telling at what angle the other vessel is moving, whether she be directly crossing his bow, or at 90° to his own keel, or at a very much smaller angle. In one case the chances of collision would be less than in the other.

During fogs steamers usually blow their whistles at intervals; they also blow one or two sharp blasts on approaching another vessel, according as they mean to go to one hand or the other. A sailing vessel during a fog sounds her bell or blows a fog horn, according as she is on one or the other tack.

It is clear that these very rough means of denoting position leave a great deal to the guess work or judgment of the helmsman, much more indeed than would be the case did a good system of signals exist, by which a vessel, by sound or by lights or by a combination of both, could indicate her course. One signal for each point of the compass would be needed, making 32 in all, and the requirements would be simplicity, clearness, and readiness in changing one signal for another. A really efficient set of such signals would probably be adopted by all maritime nations and would prove very remunerative to the inventor.

CARBON BURNED IN AN ELECTRO-CHEMICAL BATTERY.

It seems probable that when the discovery shall have been made of how to oxidize carbon in the galvanic battery, the cheapest source of electricity will have been attained. The most economical means of producing a current now known is by the magneto electric machine driven by a steam engine, the energy of the coal being converted into electricity with less proportionate waste than under any other circumstances.

M. Jablochkoff, the inventor of the electric candle, has lately been experimenting upon a battery wherein carbon is to be consumed. From the note describing the same, which he contributes to the French Academy of Sciences, he appears chiefly to have renewed the experiments of Crookes, and the results which he reports are, therefore, to be ascribed to the addition of certain metallic salts, which must exercise a potent effect toward increasing the power of his pile. Crookes' battery, in which carbon is oxidized, consists of an iron ladle, which serves both as a containing vessel and as the non-attackable electrode. In this he melts nitrate of potash, and into the liquid thus produced he plunges his carbon. The oxygen in the nitrate with the carbon produces carbonic acid, which unites with the remaining potash, forming carbonate of potash, and by the chemical action a current of electricity, which "affects the galvanometer," is liberated. A better current is obtained by a plate of platinum placed with the carbon in the fused salt.

Jablochkoff's new plan is essentially the same. He rejects the platinum in favor of iron alone, and suspends his carbon in a wire basket in the liquid; but he says by adding different metallic salts he is enabled to vary the power of the battery and the rapidity of expenditure of carbon, and with these salts there is received a galvano-plastic deposit of the metals on the non-attackable electrode.

The electro-motive force of the battery varies between 2 and 3 units, according to the nature of the metallic salts used, and is, therefore, superior to that of the Bunsen or Grenet elements. The Bunsen pile gives at maximum 1·8 units, and the Grenet 2, or under best conditions, 2·1 units. During the working of the battery, there is a large disengagement of carbonic acid and other gases, which M. Jablochkoff proposes to store up and use as motive power.

DRAWING ON THE BLACKBOARD.

The chalk used should be square in section, so that, when desired, a line of uniform width can be obtained, which is difficult, if not impossible, with conical-shaped pieces of chalk. A short wooden chalk or crayon holder with a bunch of wash-leather, chamois skin, or soft cloth, is a good device for keeping the fingers free from chalk, and erasing lines. Blackboard compasses and "straight edges" of different lengths prove useful to those inexpert in drawing circles, curves, and straight lines by the eye, but constant care and practice will, in course of time, enable the delineator to dispense with frequent use of them. They should be used as seldom as possible.

Vertical lines should be drawn from above downwards; the weight of the hand and arm should be allowed to fall naturally. The delineator should stand with his right shoulder opposite the vertical line to be drawn Horizontal lines are made with the greatest facility when a fixed and firm point has been made to the left, and the arm and body are moved with the hand from left to right, thus steadying

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the hand and keeping its position relative to the body the same. In drawing curved lines, it is well to make a few dots in the path the curve has to traverse; not more than four or six for any curve, but enough to guide the eye and give confidence to the hand. Passing the chalk point over the place where the intended curve is to be, without marking, is also useful, as it accustoms the hand and arm to the motion and change of joint required by the curve. Rapid drawing will not be acquired at once; speed will increase with practice. Left curves should be drawn first; and when drawing the balancing forms on the right hand, the eye should take in not only the curve in process of formation, but that already made, and to which it is symmetrical. The delineator will find it is better to draw with the whole arm extended from the shoulder joint than from the elbow or wrist, the face not being nearer the board than a distance of two feet in a perpendicular line to its surface. Supposing the shoulder joint to be a center and the extended arm a radial one, circles can be drawn rapidly and with astonishing accuracy.

The diagram should not extend much above the delineator's head, for above the head the hand will lose its power; nor below the elbow when the arm hangs at the side, for to draw then brings the head close to the board, and prevents a clear view. If it be necessary that lines be made both above and below these points, the position of the body and head must be raised or lowered, so as to avoid stooping or straining, which prevents good work.

Drawing on the backboard without the aid of compasses or rule may be considered as the most perfect illustration of the expression "free-hand drawing;" and to acquire the art, the hand and arm should be quite free and supple in their motion, otherwise graceful curves and fine lines cannot be made.

Students should commence delineation on the blackboard by first drawing vertical, horizontal, and oblique lines, following this up with the shading of cylindrical, conical, and cubical forms, by means of lines of different widths at different distances. Colored chalks may be used when experience has been gained; and by the use of these, pleasing effects are obtained, delineations are made intelligible, and the subject more easily remembered. The relative position of the body to the blackboard and the manner of using arm and hand, as given above, should receive special attention and practice at the outset.

COAL DUST FUEL.

We are in receipt of several queries as to the best method of using coal dust as fuel under steam boilers. To these inquirers the following data, kindly sent us by Mr. C. J. Sanborn, of Quincy, Mass., will doubtless prove of interest. Mr. Sanborn states that he avoids dust by slightly dampening the screenings, and he regards plenty of boiler room as a prime necessity. His boiler is 4 feet in diameter by 14 feet in length, with 50 three inch tubes, 20 square feet of grate surface, and artificial draft produced by a blower. The engine is 14 by 36, cutting off at ⅛ stroke, piston speed 280 feet per minute. Power is supplied to six granite polishing machines, two large polishing lathes, large grindstone, pump and blower. Consumption of coal dust 1,000 pounds per day of 10 hours, with, say, 300 pounds of Cumberland coal. Cost of dust $2.50 per ton. The grate surface is composed of flat plates running the length of the furnace, with about 80 one half inch holes to the square foot. It should be added that in this case the feed water is delivered to the boiler nearly cold on account of the small size of the heater, and it is also charged with salts and lime, rendering frequent blowing-off necessary.

GOVERNMENT SCIENTIFIC WORK.

THE geological and geographical work conducted under the auspices of the United States Government during last year is divided by the Secretary of the Interior, in his late report, into two divisions. The first is that under the direction of Professor F. V. Hayden, and the second that commanded by Major Powell. The area surveyed by Prof. Hayden's parties begins at the northern line of the belt of country already explored and mapped in detail by the survey of the 40th parallel, and extends westward from the longitude of Fort Steele, Wyoming Territory, to that of Ogden, Utah, and northward to the Yellowstone National Park. The primary triangulation party established 26 main stations and surveyed 25,000 square miles, and the topographical and geological parties surveyed 28,000 square miles, and erected monuments at all the important geodetic stations. The regions suitable for arable, pastoral, or mining purposes have been carefully examined and classified, the volume of water in streams adapted to irrigation purposes has been measured, and studies made into the best methods for reclaiming barren lands. Special investigation of the doubtful points in the geological structure of the Rocky Mountain region has shown that, while certain of the groups of strata possess each certain peculiar characteristics, and are recognizable with satisfactory distinctness as general divisions, they really constitute a continuous series of strata, with no well-defined planes of demarkation, stratigraphical or paleontological. Another interesting result of the surveys is the probable determination of the ancient outlet of the great lake that filled the Salt Lake Basin. It is thought that the waters flowed northward, by way of Marsh Creek, into the Portneuf, thence into the Snake River, and thence into the Columbia River. The source of Marsh Creek is in the lowest pass between the drainage of the Great Basin and that of Snake River. The publications of the survey have been exceedingly voluminous.

Major Powell's party has worked within the Territory of Utah, surveying volcanic plateaux, classifying lands, examining large areas of pine timber, and locating important and valuable coal fields. It is stated that the area of the territory that can be redeemed by irrigation through the utilization of all the streams, but without the construction of reservoirs, is about 1,250,000 acres. The ethnological work of Major Powell's party has been very extensive.

A commission composed of Professors C. V. Riley, Cyrus Thomas, and A. S. Packard have been engaged in the study of the Rocky Mountain locust. Professor Riley's determinations relative to this insect we have already placed before our readers. The work of this commission has been of great value, as it has laid the way for future investigations which will result in the probable abatement of the evil.

With regard to the Yellowstone Park, Secretary Schurz states that nothing has been done, and he recommends appropriations for the laying out of roads and support of other measures calculated to render the natural wonders of the region attractive and accessible.

Microscopic Masons.

The *Melicerta ringens* is a microscopic organism which possesses a building apparatus, by the aid of which it manufactures infinitesimal pellets, specific in shape and in situation, and in altitude when placed in position. The gathering members resemble a series of cog wheels which, by rotating rapidly in different directions, produce a stream, which passes by a special organ which selects from its current those particles suitable either for eating or building purposes, by dividing the main stream into four smaller ones. One stream glances off a kind of cushion and is deflected as food to the eating apparatus, another carries off the waste, and the third and fourth go to the pellet or brick making organ.

This last is of cup shape, and moulds the pellet in the form of a Minié bullet, mixing it with glutinous material and rolling it just as a boy makes a snowball. It then passes to another wonderfully delicate little member, which converts the ball into a cylinder, and the brick which is to take its place in the wall is made. In an inconceivably short space of time the particle is grasped, turned, and fixed in position in the row of other pellets which are laid with wonderful neatness and regularity.

While the *melicerta ringens* is a brick maker and brick layer, the *Limnias annulatus* is a plasterer. Mr. F. A. Bedwell, in the *Monthly Microscopical Journal*, says that it secretes fluids and rough particles, and with these it rough-casts its tube on the outside and then stuccoes it smoothly on the the inside, and finally smooths down the exterior surface exactly as a bricklayer smooths his stucco with his flat trowel.

The Centripetal Railway System.

The New York Board of Trade and Transportation has issued a pamphlet describing the Centripetal Railway system devised by Mr. Albert G. Buzby. This consists essentially of a substantial permanent way, composed of a center or bearing rail and two outer or steadying rails, combined with distance or brace pieces so as to form one continuous structure. The cars and locomotives have double-flanged bearing wheels adapted to the center rail, and side steadying wheels without flanges adapted to the outer rails. Each set of wheels has a separate and independent axle, and all are arranged so as to have a swinging and lateral as well as perpendicular motion, each independent of the other. It is claimed that the load is mainly carried on the center rail, and that there is no grinding action in passing over curves. The center rail may have a face of any width, and thus the adhesion of the locomotive wheels is materially augmented, admitting of the use of heavy gradients. Curves of fifty feet radius are claimed to be possible under the system, and the inventor suggests its adaptation for elevated rapid transit roads, the arrangement proposed being three iron I beams, combined with longitudinal timbers and brace pieces.

What's in a Name?

Trials of the Bell telephone were recently conducted before the Emperor of Germany at the palace in Berlin. His Majesty manifested the liveliest interest in the invention, and deigned to inquire its name, whereupon a high Post Office functionary coined the title, "Fernsprecher," which means "Far talker," and which the Emperor at once approved, so that it is now a part of the German language. The acquisition of an Imperial godfather for his device may perhaps console Professor Bell for this remarkable change in the baptismal title of his offspring, although he will probably agree with us in failing to see the improvement. Still, when he remembers that the name emanates from the nation which inflicts suffering chemistry with "anisdibenzhydroxylamene" and a host of like jaw wrenchers, he may be grateful that the infant telephone is not smothered under the usual Teutonic avalanche of syllables.

Habits of Moths.

A correspondent of *Nature* describes some interesting experiments upon moths to test their sense of smell and hearing. Certain moths when captured feign death. While they are thus motionless, if a sharp sound be made such as is produced by striking a piece of glass, they will be suddenly roused and will attempt to fly. On the other hand, a strong solution of ammonia, uncorked close to moths, has no effect in driving them away; they do not seem to smell it and only move away from the fumes slowly when oppressed by them. The latter experiment must occasion surprise, because it was believed that moths possessed an unusually effective sense of smell, since the males of certain species will come from great distances to visit a female kept in captivity, and it has been hitherto supposed that they were guided in their quest by the olfactory sense.

Endemic Tetanus in Long Island.

In the eastern portion of Long Island there has existed for many years an endemic tetanus of both the spontaneous and traumatic varieties. Cases of the disease are known to have occurred in one in about every 200 wounds, or about 150 times as frequently as it happens in New York city. Again, it seems to be confined to a particular county, the southern and central parts of which are exposed to ocean air, salt air from bays, and to the mingling of fresh and salt water. The disease is also most fatal in the months of July, August, and September.

Dr. George M. Beard has recently investigated the phenomena of the malady, and he comes to the conclusion that it is in no wise owing to the large amount of decaying fish about the vicinity, but is due to the dampness of the ocean air, combined with the local dampness of the soil. He holds the pathology of the disease to be in general a cold in the spinal cord, which has been made irritable by irritation propagated from some form of peripheral injury. The remedies recommended are Calabar bean and application of ice to the spine.

A 502 Dollar Rooster.

That famous $50,000 cow which was so much talked about in this country a few years ago, has found a rival in point of proportionate pecuniary worth in a $502 chicken. The *English Agricultural Gazette* says that a game cock was recently sold for the above excessive price, and suggests that in the future the raising of such chickens would prove a very lucrative source of income. The same journal, we notice, says that over $13,000,000 worth of eggs were imported into England in 1876, and yet the supply was short of the demand. Here is an opening for poultrymen, and a wider field for inventors of egg-preserving processes and egg-carrying devices.

The Telephone and the Telegraph.

We have received several letters from correspondents narrating instances of the telephone's reporting messages from neighboring telegraph wires. In answer to numerous queries as to the cause of this, we would say that it is occasioned by the inductive effect of the electric currents on wires near and parallel with the main line with which the telephone is connected. The use of two wires for the telephone (parallel and near together) would be very apt to neutralize this effect of other wires, by causing it to act in opposite directions, through the spool wire in the telephone, which would of course have its two terminal wires connected direct with the two line wires and be independent of any earth connection.

TO OUR SUBSCRIBERS.

In accordance with our usual custom, at the beginning of this new year we turned over a new leaf in our subscription book, placing thereon only the names of those whose subscriptions have been renewed, or that have not expired.

All whose papers have ceased to come may know that their subscriptions have expired; and we hope they will be prompt in sending the money, $3.20, for renewal for one year, or $1.60 for six months. We will supply the back numbers, commencing with the year.

Remarkable Marksmanship.

Captain Bogardus, a well known marksman, recently accomplished in this city the remarkable feat of breaking 5,000 glass balls inside of as many consecutive minutes, the missiles being shot from a double barreled gun. The balls were thrown up from spring traps and were shattered in the air. The feat was accomplished with a margin of 19 minutes and 25 seconds to spare. It is stated that the weapon, weighing 10 pounds, was lifted and aimed 5,300 times, which work is equivalent to 318 foot pounds per minute, accomplished by the arms alone and continued for over 8 hours. This must be added to the brain work involved in aiming the gun, in order to perceive the nature of the remarkable skill and endurance of the marksman.

A Great Oil Pipe Line.

A new oil pipe, known as the seaboard pipe line, is soon to be laid from Butler county, Pa., to Baltimore, a distance of 230 miles. The transporting capacity will be 6,000 barrels of oil per day, and the flow will be incessant. It is expected to bring into Baltimore annually about two million barrels of crude oil, about equal to the quantity now carried there by two railroads.

THE Boston *Journal* says that the shipbuilding tonnage of Maine for 1877 has reached 76,308 tons, showing an increase over that of 1876 of 2,734, and over that of 1875 of 1,247 tons.

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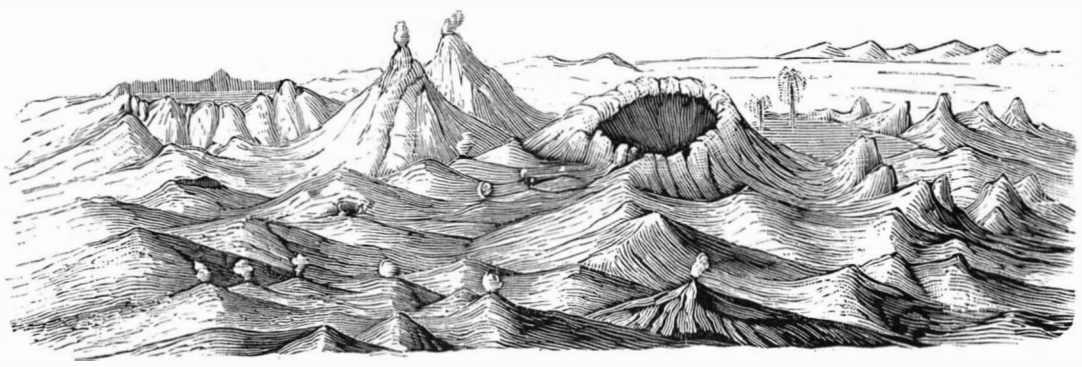
Feeding Horses.

For a period of over 30 years, more or less, says a correspondent of the *Country Gentleman*, horses have been under my control. I personally superintended the feeding. During this time no horses have died, and I have had little sickness. A straw cutter, with rawhide rollers, has been in continual use till the present time. In the cutting of the food for two teams, enough is saved in one year to pay for its purchase. While the horses are eating their dinner, enough can be cut for the next meal; then watered, to moisten it and destroy the dust, and with it four quarts of meal is ample for each horse. The meal is one third corn, one third oats, and the other shorts. A variety is made by giving a few small potatoes or carrots weekly. The benefits resulting from this manner of feeding are that we have no sick horses, they being always in good health and order; there is no danger of founder from hired men feeding when too warm: they can eat it sooner, and are ready to go out; neither is anything wasted (by throwing from the manger, etc.), and it does them more good, I believe, as no whole grain is passed and lost. Being out of meal for a few days, a number of feeds were given them of small ears of corn, with plenty of cut hay, moistened. Two had to be taken to the city immediately for treatment of colic, and, by prompt action at once, they recovered. This is the last of whole grain feeding. Of course the same good quality of hay and grain is given when cut as when they cut it for themselves.

THE COLORADO MUD VOLCANOES.

The curious mud volcanoes of Southern Colorado are located about ten miles to the southeast of Mount Purdy, an extinct volcano, some 600 feet in height. The remarkable aspect of this region is well shown in the annexed engraving, from *La Nature*. In its center is a mud lake which constantly boils, throwing up jets of thick viscous liquid. Around this seething cauldron are hundreds of craters of dry grayish mud. The cones are from three to six feet in height and five to twenty feet in diameter. Some, having a narrow opening, eject sulphurous vapors; others, with large mouths, seem filled with mud, which they throw out at irregular intervals to heights of from four to six feet. The temperature of the mud and of the sulphurous vapors is about 210°. A small stream of clear water near the central lake reaches 199°, and ponds in the neighborhood are found to be respectively at 96° and 100°. Lieutenant Wheeler, in his geographical survey, discovered a vast hill near this mud lake which was the product of ancient eruptions. The soil is chiefly composed of sulphur, which exists in many cases in a purely crystalline state.



THE COLORADO MUD VOLCANOES.

It has been suggested that the pitted surface of the moon might be caused by volcanoes of this sort.

THE REGNIER ELECTRIC LIGHT.

We take from *L'Inventeur* the annexed engraving of a new form of the Regnier electric light, which operates continuously for 24 hours. The essential feature of the apparatus is the circular carbon plates used instead of points, the voltaic arc passing between the edges of the rotary disks.

The device will be easily understood by the following reference to the illustration. *a* is the base, *b b b' b'* forked standards, *d d'* carbon disks or rheophores having a continuous rotary motion imparted to them by the clockwork motors, *f* and *f'*. At *g g'* are the trunnions on which both disks and motors oscillate; *i h* is a forked lever connected to the motor, *f*, by a long curved rod; *k* is a button screwed on the end of this lever, and ending in the cup, *l*. By means of this screw the motor, *f*, is caused to move backward or forward in order to adjust the carbons. *m* is a solenoid commanding a soft iron magnet (not shown).

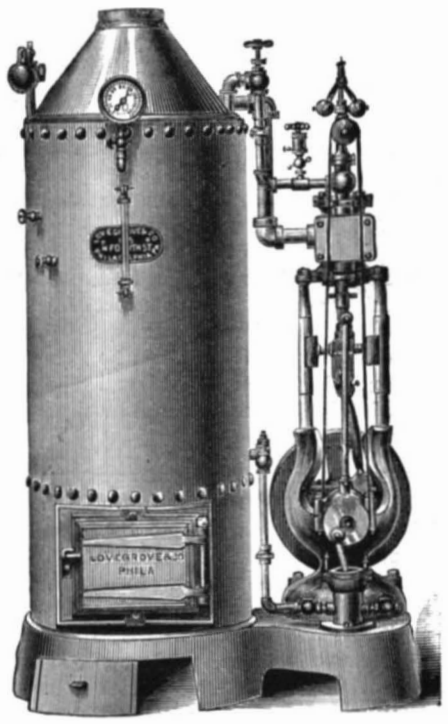
Through the rod, *p*, crank, *r*, and arm, *s*, this magnet pulling downward moves the motor, *f'*, to the rear and determines the separation of rheophore, *d*. At *t t* are springs moving the rheophore, *d'*, in contact with the rheophore, *d*, to establish the light. These springs, attached at *u* and at *v*, act on the motor, *f*, through crank, *r*, and arm, *s*. *x y x* is a forked lever attached at one end to the springs and carrying at its other extremity a set screw by means of which the springs are more or less extended and the lamp regulated. At 2 and 3 are the binding screws for the battery wires.

Progress of the Great Jetties.

Captain M. O. Brown, U.S.A., Government Inspecting officer at the mouth of the South Pass of the Mississippi, has made a survey which shows a twenty-two foot channel over two hundred feet wide, entirely through the works; and a practicable channel with a least depth of twenty-three feet. This entitles Captain Eads to the second payment of $500,000. The Secretary of War will have a survey made by a special board of engineers before making the payment.

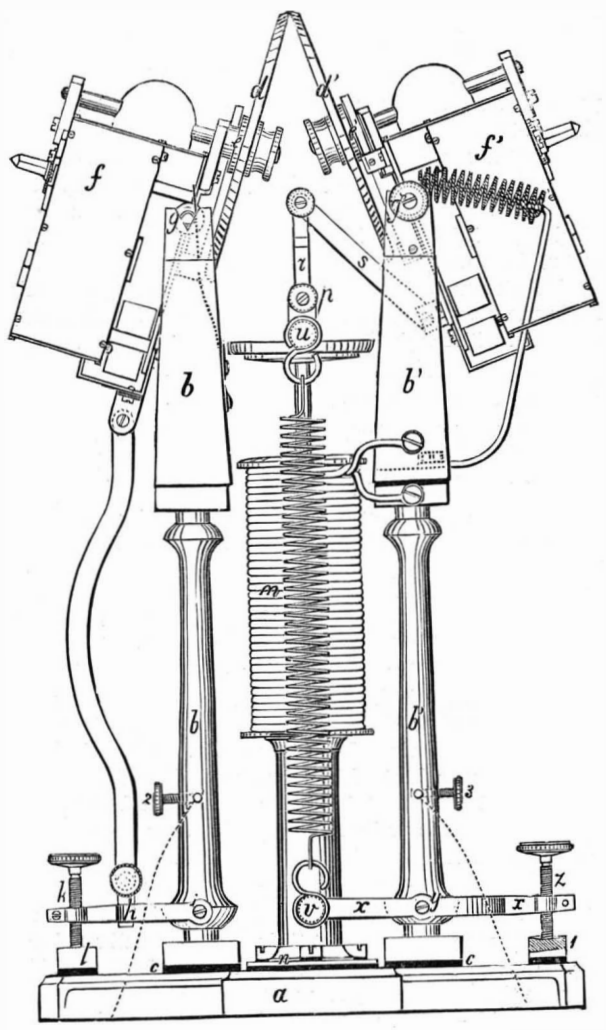
LOVEGROVE'S TWO-HORSE POWER ENGINE.

We illustrate herewith a small two horse power engine and boiler which the manufacturers claim possesses all the qualities of durability, good design, and economy of fuel.



The cylinder is of the ordinary three-ported construction, and the steam chest is cast upon the cylinder. The piston is cast iron with self-adjusting packing rings which work free. Suitable provision is made to take up lost motion wherever it is likely to occur. The bearings are long and large. The pump is connected to the shaft and is driven by a crank. It is so placed as to be accessible at all times. The base is in one piece and so constructed as to admit of belting from the fly wheel in any direction. The diameter of the cylinder is 3 inches, stroke 4 inches; fly wheel 12 inches diameter, 3 inches face, turned for a belt. The boiler is made of the best charcoal hammered iron, has lap-welded tubes, and is tested to 200 lbs. pressure before leaving shop. It is of the vertical tubular type, 18 inches in diameter, 42 inches high, with twenty 2 inch tubes 30 inches long. It is furnished with grates, base dome, safety valve, steam gauge, water gauge, gauge cocks, blow-off cock for check, and cock between boiler and pump, complete and ready to run.

For further information address Lovegrove & Co., manufacturers, 121 South Fourth street, Philadelphia, Pa.



THE REGNIER ELECTRIC LIGHT.

New Mechanical Inventions.

Messrs. Estavau Gorriti and Pedro Unanue, of Navarre and Guipozcoa, Spain, have patented a new Automatic Feed Water Regulator for Steam Boilers. Water chambers are arranged on the top of the boiler, which are, by suitable connections, alternately filled with water and discharged into the generator. The arrangement is such that the required quantity of water is always supplied, whether the tank is located above or below the water level. In the latter case the regulator acts as a feed pump.

A new Brick Machine, devised by Mr. R. W. Brownhill, of Walsall, England, is an improvement upon that class of apparatus in which a vertical plunger drives down the clay from the hopper into a mould. The clay is afterwards pushed to one side, and compressed into shape by steam-heated plungers actuated by cams. The brick then passes to a traveling belt for removal.

Mr. W. H. Field, of Taunton, Mass., has improved upon the Nail Plate Feeder patented by him December 14, 1875. The new features are exceedingly ingenious but cannot be clearly described without the aid of drawings. Their effect, however, is to render the machine more reliable and accurate in operation and less liable to get out of order or to need adjustment.

An excellent device for bookbinders has been invented by Mr. Carl Theene, of Minden, Germany. It is a Book-Stitching Machine, constructed on the general principle of a shuttle sewing machine, with a needle-lubricating apparatus attached to the presser bar and foot, and a continuous feed and guide arrangement that is adjustable for the different sizes and thicknesses of boilers.

In order to extract the silky Fibers from the "Pita" Leaf, Mr. Carlos de la Baquera has devised a machine, which embodies a scutching wheel of peculiar construction, and also an adjustable chute and holder. The action of the scutching blades, hackling combs, and wire brush, effectually removes the outer coating and pulp from the leaf, leaving the fibers clean and unbroken.

No less than thirteen new devices are embodied in the Brick Machine recently patented by Mr. Z. Vanier, of Westborough, Mass. After being placed in a hopper the clay goes to a cylinder and thence to moulds, being agitated and wedged downward by blades. Toggle devices afford the pressure, and the bricks are then carried forward and discharged by a follower, a table having risen to receive them. The entire construction is ingenious and mainly new.

Mr. Edward L. Byron, of Moes River, P. Q., Canada, has invented a new Hand Truck, the frame of which, when it is used for moving small packages, rests upon the axle. When, however, large bundles are to be carried, the frame may be easily elevated and the load thus raised above the wheels.

In a new Machine for Filing Gin Saws, patented by Mr. Patrick O'Neill, of Murfreesborough, Tenn., three-cornered files are suitably held and caused to reciprocate by a crank movement. Means are provided for moving the saw cylinder ahead, guiding the files, etc. The apparatus is an ingenious and efficient machine.

A new Windmill has been patented by Mr. John J. Reed, of Lyons, Iowa, which is so made that the wind, as it increases in force, will turn the wheel more and more aside, and finally stop it. Means for accomplishing the same end by hand are also provided. The vane may be made more or less sensitive to the wind by a simple adjustment.

Royal C. Grant, of Middleport, Ohio, has patented a Rotary Nail Machine for making cut nails. The nail plates are placed in a vertical hopper having spiral inclines for guiding them into the feed tube, by which they are held and rotated while being cut into blanks. Each plate is oscillated in a vertical plane, to change its inclination to the cutters, by means of spring bars, which press against the side edges of the plate and are oscillated by a tappet at each half revolution of the feed tube. The cutting, gripping, and heading devices are attached to a rotating cylinder, located directly beneath the tube through which the nail plate is fed, and by which it is rotated. The end of the nail plate is gripped, the blank cut off, then lowered into alignment with the header, next gripped by a die, and finally headed and released from the gripping device, and delivered from the cylinder into a suitable receptacle.

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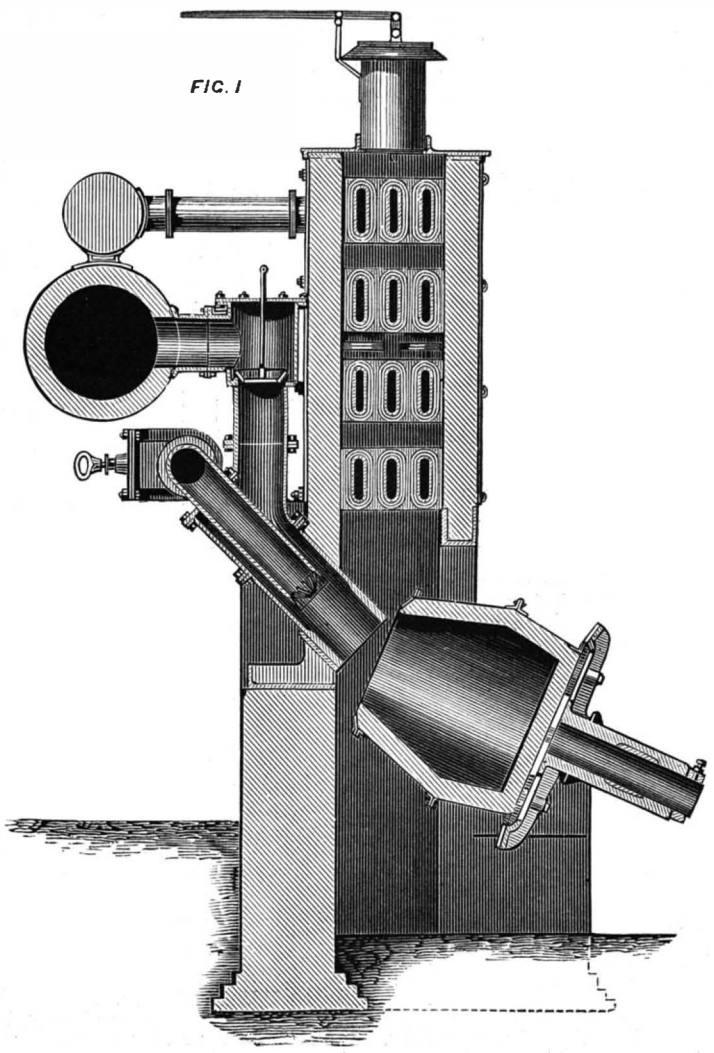
THE GODFREY AND HOWSON PUDDLING FURNACE.

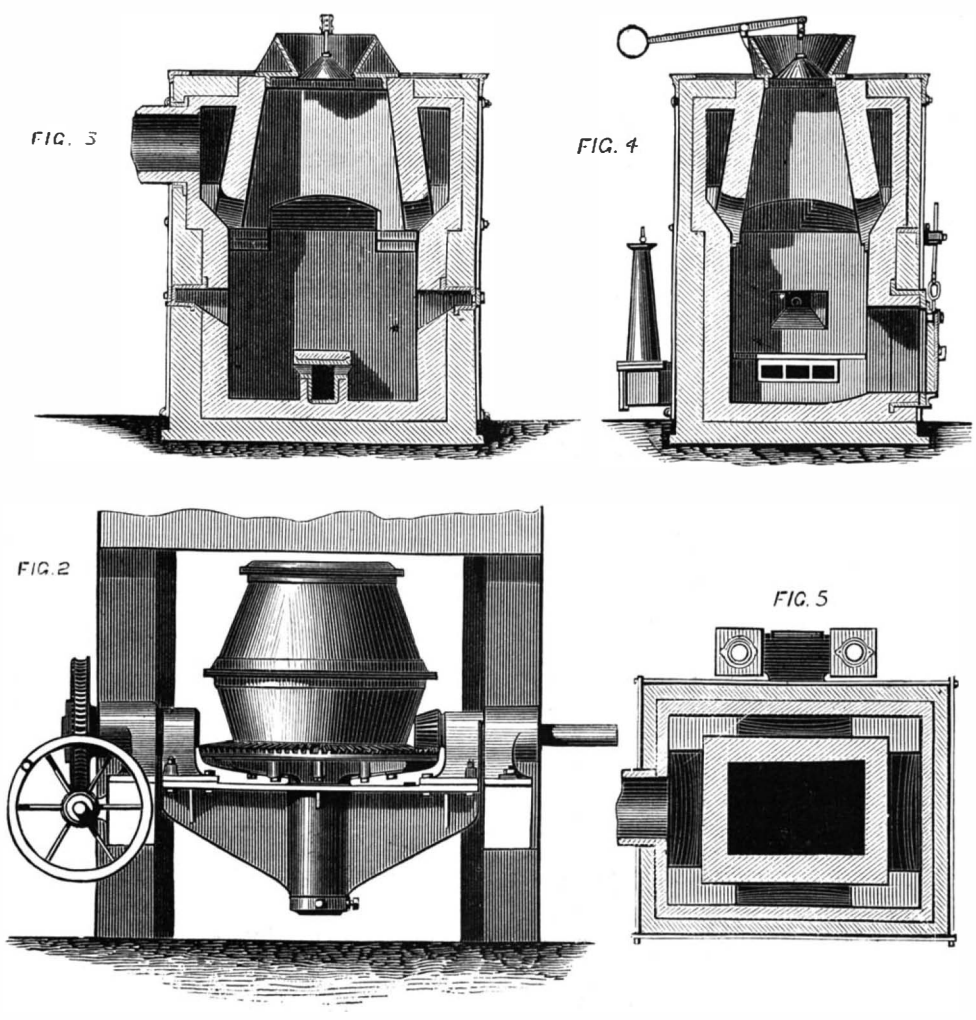
Mr. R. Howson lately described the Godfrey and Howson puddling furnace before the Iron and steel Institute of Great Britain. The acting part of the machine consists of a pan-shaped vessel, Figs. 1 and 2, mounted on an axis. This axis is inserted into a long bearing bored out in a framing situated immediately below the pan, a bevel wheel, driven by a pinion, being keyed on the axis between the bottom of the pan and the frame. The frame itself is mounted on trunnions, which allow of a tilting motion at right angles to its bearings. The shaft of the pinion, which causes the revolution of the pan, passes centrally through one trunnion, while on the other trunnion a worm wheel is keyed, worked by a worm, through which the tilting motion is effected. It will thus be seen that the pan can be revolved at an angle; its position can be changed through an arc of a circle, so as to bring its opening at one time in front of the source of heat, and at another to tilt out the finished ball. The center of motion is situated a little above the bottom of the pan, and the weight of the trunnion frame is adjusted so as to balance the weight of the pan and its contents. The source of heat consists simply of an enlarged gas blowpipe, the jet from which enters the mouth of the pan centrally or nearly so, while the products of combustion escape concentrically outside the tuyere and inside of the edge of the pan. The gas enters from the main into an annular space just above the tuyere, and the air is forced through a nozzle placed centrally and perforated with holes. The nose of the center tuyere is protected from the heat by means of a coil, after the manner of a blast furnace, but instead of water it is sufficient to allow a small jet of steam to circulate through it, this alternative being designed to obviate the consequences of a leak, which might result in a chance explosion in the pan. The air nozzle itself requires no protection.

The pipe which conducts the gas from the main to the tuyere is fitted with a simple valve for shutting off the gas and regulating its supply, There is also a valve attached to the air pipe for a similar purpose. The pressure of air which appears to be most suitable so far, may be stated to be about 12 inches of water. The burnt gases, whether incandescent or not, after issuing from the pan, have a high temperature. This waste heat is conveniently utilized by allowing it to pass on its way to the atmosphere by a vertical chamber traversed by a series of heating pipes through which the air is forced on its way to tuyere.

The apparatus for generating the gas is that of Messrs. Brook and Wilson. This (Figs. 3, 4, and 5) consists of a combustion chamber having a solid hearth and no fire bars. The coal is fed from the top, the combustion takes place at the bottom, and the gas escapes intermediately between the two, through lateral openings into a channel which passes round the chamber, and from which channel it is conducted into a main communicating with the furnace, or with a number of furnaces. The air required for combustion is supplied by means of the steam jet, blowing into a bell-mouthed pipe placed outside, but mounted on a box-shaped casting which traverses the middle of the chamber. On each side of this box, in the interior, there are openings through which the mingled air and steam find their way into the charge. The object of placing these openings in a central position is to prevent any currents from passing up the sides of the chamber in an undecomposed state, and contaminating the gas, as they are liable to do unless the proper precautions are taken. The steam jet prevents an obvious advantage, as it gives command of pressure at the tuyere to assist the blowpipe action, affording at the same time a ready means of adjustment so as to regulate the rate of combustion and the formation of gas according to requirement. We take our illustrations from the *Engineer*.



THE GODFREY & HOWSON PUDDLING FURNACE.



THE GODFREY & HOWSON PUDDLING FURNACE.

New Inventions.

An Ornamental Chain patented by D. D. Nevins, of Attleborough Falls, Mass., consists of short pieces of wire, having loops in their middle parts and having their ends bend outward, rearward, and inward to form rings or loops. It is neat and ornamental, and suitable for watch chains or necklaces.

In washbasins the stopper is usually suspended on a chain suspended outside the basin. Herbert W. Carnes, of Brookline, Mass., has patented a Stopper which works without a chain. It is suspended by lugs and a pin to a lever, one end of which is hinged to the strainer pipe and the other provided with a handle, by which the stopper may be taken out of or inserted into the strainer pipe.

William. R. Young, of Healdsburg, Cal., has patented a Combination Padlock which is an improvement in the class of keyless or permutation padlocks. It consists in providing the screwthreaded plate which closes the open end of the padlock with holes to receive the reduced ends of the U-shaped staple for the purpose of preventing access to the interior locking mechanism. The plate renders the padlock stronger and more capable of resisting force.

Robert Brass, of Brooklyn, N. Y., has patented a Feed Bag with two wire ventilators in the front. The flanges are attached in such a manner that the ventilator is prevented from tearing out of the bag.

George F. Shaver, of Mooheadville, Penn., has patented a Device for taking Mail Bags upon and delivering them from a Railroad Mail Car while in Motion. A rod on the car seizes a bag suspended from the road side crane, while another rod on the latter, at the same time, takes a bag suspended from a frame attached to the car. The bag entering the car slides inward and strikes a curtain, so that it is subjected to no injurious shock.

Charles W. Helden, of Florence, Ala., has patented a Vehicle Wheel which is designed to secure greater strength and durability and to obviate the welding of the axle. It consists in the peculiar construction and arrangement of the hub and its connections, in which the extremity of axle is tapered squarely to the end and a flanged non-rotating hub fitted over the same with a square perforation, while the box is provided with a flange and revolves upon the fixed hub, its flange being bolted to a collar upon the opposite side of the spokes, so as to hold the latter in place.

Thomas A. McDonald, of Durham, N. S., Canada, has patented a Shoelace Fastening. It consists of a single spring finger made in a continuous piece with and bent around parallel to a perforated base plate which is affixed to one of the flaps by clips and an eyelet, the said base plate and spring finger being each perforated, so that, when the cord is passed through the perforations in the base plate and the finger, and is then wrapped around the finger, a tension upon the cord from the straining movement of the foot presses the spring finger tighter against the base plate and cramps and binds the folds of the cord wrapped around the same, thus increasing the security of the fastening in proportion to the increased strain upon the cord.

Benjamin E. Atwood, of Newville, Cal., has patented a Brake Shoe Holder for Wagons. It is an improvement in the class of clamps for the shoes of wagon brakes, which have an adjustable jaw to enable the shoe to be inserted or detached and another substituted, when required, with convenience and dispatch.

Calvin S. Powers, of Fountain, Minn., has patented an Electro-Vapor Bath. The novel features consist in the arrangement of a hammock with enclosing boards, doors, and head rest, whereby the current may be applied to the patient in either a sitting or reclining position; and in forming the foot rest in the shape of steps with a foot bath in the lower one and a metal covering to their surfaces to constitute one of the electrodes. Revolving and adjustable electrodes are used for applying the current to the back and loins, and there is an arrangement of sectional doors whereby the legs and arms may be treated independently of the rest of the body.

A Sash Holder patented by D. O. Hink, of Maryville, Mo., consists of a plate, to which is pivoted a lever upon which a curved cam is formed, which has two working surfaces, on its side and on its edge. When the cam lever is employed in locking a window it is let into the stile, and is used in connection with a sliding piece which is carried by a lip. A wedge-shaped recess is formed in this piece, in which the cam turns, so that when the cam lever is turned the window is clamped between the pulley stiles and also between the stops.

Louis Prahar, of New York city, has invented an improvement on his Pocketbook Clasp, patented May 23, 1876. A hook is formed upon the rear end of the lower plate and a loop or keeper upon the tail of the top plate. The forward end of the spring is secured to the lower side of the plate by a stud. The free end passes back and rests against the end of the tail of the top plate and holds it in position.

A novel Office Chair has been patented by Martin Schrenkeisen, of New York city. The side posts of the back of the chair project a little below the seat, and to them are attached the rear end of bars, whose forward ends are pivoted to brackets fastened to the pedestal of the chair. Springs are coiled around arms of the bracket. By this construction the back of the chair is held upward and forward, so as to fully support the sitter when leaning back, and bear against his back when sitting erect and leaning forward.

A Horseshoe invented by H.L. Homan and George W. Homan, of Easton, Mo., consists in two calks, having formed on them screw-threaded shanks, which are fitted to corresponding holes in the shoe, and are prevented from turning by a key fitted to notches formed in the side of the calks. They will resist all strains and are readily replaced when worn.

In a Harness Saddle patented by S. E. Tompkins, of Sing Sing, N. Y., the strengthening rib of the seat has a projection underneath through which is an eye. Upon the upper side of the rear edge of the saddletree is a pin projecting to the rearward and through the

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eye of the seat projection. The seat and saddletree are thus simply and firmly connected together.

Ole H. Larson, of Fort Dodge, Iowa, has patented a Ventilating Beer Faucet. A flexible tube with split bulb, and connected with the outside air, forms part of the faucet, and is forced into the liquid where the bulb floats on the surface, thus admitting of a free passage of air. It is an ingenious and good device.

Mr. William A. Cates, of Union, Oregon, has devised an ingenious clock, the dial of which is so subdivided as to indicate the 24 hours of the day. It is arranged with a revolving face plate having a map of the earth on a polar projection, the face plate being placed on the hub of the hour hand. A loosely moving and graduated index hand is placed on the hub of the hour wheel, for indicating the time and geographical position of any place on the earth.

Mr. Daniel G. Beers, of Sandy Hook, Conn., is the inventor of an improved clothes wringer so constructed as to allow the rollers to spread while operating upon large or thick fabrics without throwing the gear wheels out of engagement.

Zelotes McKinler & Virgil True, of Laclede, Mo., have patented a Gas Stove, which is designed to provide an economical form of cooking stove especially adapted to small families and for summer use. It generates its own gas from a burner, without the use of a wick, by volatilizing, through the heat of the burner, a limited quantity of the volatile oil admitted to the burner from a reservoir placed above the same. The improvements consist in the particular construction and arrangement of the pipes with respect to the reservoir and the supports or stoves for the cooking utensils.

John Miller, of Petersburgh, Pa., and William B. Miller, of Altoona, Pa., have patented a Shaft Tug, an improvement upon that form of shaft tug which is provided with an internal protector to receive the wear of the shaft; and it consists in the peculiar construction and arrangement of the parts whereby the protector may be taken out and replaced, when worn, without deranging or destroying the tug strap.

A Pill Machine invented by Dr. John Hill of South Norwalk, Conn., consists of a series of blades fixed to a vibrating bar, and adapted for dividing the rolls of pill mass upon a tablet, in combination with pivoted clearers which separate the mass from the cutters. The bits of pill mass are then rolled into pills in the ordinary way.

John W. Drake of Tolono, Ill., has invented an improved lamp shade and reflector, which by an efficient arrangement of conical sections and reflectors throws a strong light through the opening of the shade.

On the base of a buckle patented by T. L. Wiswell, of Olathe, Kan., is formed a hook. The end of the strap passes through the buckle, enters the hook and rests upon the ring it holds, so that it is impossible to detach the hook without loosening the strap. It is strong and the buckle does not need to be sewed on.

An air feeder for stoves has been invented by G. C. Palm, of Andersonburg, Penn., which supplies the air for combustion from outside the house. An air trough beneath the floor leading out to the outer air is connected with an air box under the stove. This box is provided with partitions, dampers, doors and two outlet pipes. One outlet pipe is connected with a sunken air chamber under the stove and the other with the bottom of the hearth. The former supplies heated air to a heater above the stove and the latter furnishes the draft.

Communications.

The Law of the Pressure of Saturated Steam with Relation to Temperature.

To the Editor of the Scientific American:

The exact law of the connection between the pressure and temperature of saturated steam has hitherto eluded discovery, notwithstanding the numerous and admirable investigations and experiments instituted on the important subject; and the respective values relied upon for practical purposes have been derived from empirical formulæ more or less simple or complex in proportion as less or greater exactness is required. I think that I have discovered the true nature of the relation in question, a result which I have obtained with the aid and on the ground of the views and conclusions set forth in my recently published pamphlet, "Nature of the Physical Forces" (Rosnan & Co., San Francisco, Cal.). The following is a brief statement of the principal facts involved.

The unit of weight of a given volume of a gas is, according to my deductions, and in conformity with the kinetic theory, equal to the square root of the weight of volume. Multiples of volume, as 2...3...4, etc., therefore involve an increase of the unit of weight at the rate of the square roots of the numbers, respectively by 1·4142....1·732....2, etc. If the number of volumes is increased, while the space occupied by them remains that of one volume, the force of expansion, which is equivalent to pressure, will increase in proportion to the weight of the number of volumes; the units of weight increasing only at the rate of the square roots of these numbers. The increase of volumes of steam in a steam boiler, consequent on the continued application of heat, is of this nature; and the pressure being at 100° C., that of 1 volume, whose weight is equal to that of a column of mercury 760 mm. high and = 1 atmosphere, is at 120° C. = 1491 mm., or nearly 2 atmospheres, at 135° C. = 3 atmospheres, etc., the units of weight being $\sqrt{760} = 27{\cdot}568$ for 1 atmosphere; $\sqrt{2 \times 760}$, or $1{\cdot}41 \times 27{\cdot}568$ for 2 atmospheres; $\sqrt{3 \times 760}$, or $1{\cdot}73 \times 27{\cdot}568$ for 3 atmospheres, etc.

The power by which additional volumes are constantly forced into the same space is increase of temperature, and it remains to be shown that the units of heat actually increase at the same rate as the units of weight of the volumes of steam, and thus to illustrate in the most striking manner the truth of the mechanical equivalence of heat.

The temperatures really increase at the rate indicated; in order to render this manifest, it is only necessary to divide the squares of temperature expressed in degrees of the centigrade scale, by 10,000. In the following, the quotients thus obtained are compared with the square roots of the units of the pressure corresponding to the temperature according to Regnault. The first column contains the temperatures; the second the units of pressure in atmospheres; the third the squares of temperature divided by 10,000; the fourth the roots of units of pressure.

100° C.	1·000	1·0000	1·0000	195° C.	13·84	3·8025	3·7198
120° C.	1·962	1·44	1·4000	200° C.	15·38	4·0000	3·9211
135° C.	3·097	1·8225	1·7579	205° C.	17·00	4·2025	4·1231
145° C	4·11	2·1025	2·0259	210° C.	18·85	4·4100	4·3414
160° C.	6·12	2·5600	2·4729	215° C.	20·8	4·6225	4·5604
165° C.	6·94	2·7225	2·6339	220° C.	22·88	4·8400	4·7831
170° C.	7·844	2·89	2·7998	225° C.	25·00	5·0625	5·0000
175° C.	8·83	3·0625	2·9708	230° C.	27·5	5·2900	5·2438
185° C.	11·12	3·4225	3·3343				

The values of the units of temperatures corresponding to the square roots of the units of pressure are slightly but uniformly in excess of the values of the latter, which discrepancy will be accounted for presently; of the existence of the exact relation there can be no doubt; and this very simple relation expressed in general terms is as follows:

The temperatures are as the square roots of the number of units of pressure; the pressure is proportional to the total weight of volumes, which is equal to the square of the square root of the number of volumes multiplied by the unit of weight; and the square of the temperature (t) divided by 10000, is the square root of the number of compressed volumes, or $p = \left(\frac{t^2}{10000}\right)^2 \times 760$; and inversely, the square root of the number (n) of units of pressure, multiplied by 10000, is the square whose root represents the temperature at the pressure of n units, or $t = \sqrt{\sqrt{n} \times 10000}$.

A comparison of the values of t and p calculated from these formulæ, with the values actually found by experiment, will show if and to what degree the theory is in agreement with facts.

The first column of the following table exhibits the temperatures, from which the pressures of the second column have been calculated, and *vice versa*; the figures of the third column are the actual pressures, according to Regnault; the fourth shows the difference:

100° C.	760	mm.	760	mm.	
120° C.	1530	mm.	1491·28	mm.	38·72
135° C.	2523·2	mm.	2353·73	mm.	169·47
145° C.	3359·2	mm.	3125·55	mm.	233·65
160° C.	4980·73	mm.	4651·62	mm.	329·11
165° C.	5633·12	mm.	5274·54	mm.	358·58
170° C.	6347·59	mm.	5961·66	mm.	386
175° C.	7127·96	mm.	6717·43	mm.	410·53
185° C.	8899·66	mm.	8453·23	mm.	446·43
195° C.	10988·84	mm.	10519·63	mm.	469·2
200° C.	12160	mm.	11688·96	mm.	471
205° C.	13421·45	mm.	12955·66	mm.	465·79
210° C.	14780·546	mm.	14324·80	mm.	455·75
215° C.	16239·3	mm.	15801·33	mm.	438
220° C.	17803·156	mm.	17390·36	mm.	413
225° C.	19477·87	mm.	19097·04	mm.	380·83
230° C.	21267·916	mm.	20926·4	mm.	341·516

The figures show, as already stated, that the actual pressures are lower than those calculated from the temperatures; there has been a loss of temperature which has to be accounted for, if the doctrine of the mechanical equivalence of heat is to be rigorously true. The loss seems to be strongly confirmatory of the correctness of the law, as above enunciated; for when the pressure of the steam is indicated by the gauge, a certain amount of the expansive energy has already been consumed in the heating and expansion of the boiler, and the work thus performed is not included in the registered tension. The discrepancies, therefore, enter as a necessary factor for the determination of the values. The loss, as will be seen, increases gradually till at about 14 atmospheres it reaches a maximum, and, after remaining nearly stationary between 14 and 17 atmospheres, gradually diminishes. This seems to be in perfect agreement with the behavior of metals under strain, their power of resistance increasing gradually up to a maximum with the increase of the straining forces. Special investigations, however, are necessary to show that the discrepancies are solely due to this cause.

San Francisco, Cal., December, 1877. E. VOGEL.

The Telephone's Freaks Again.

To the Editor of the Scientific American:

We have just completed a line eleven miles long, from this place to Cape Girardeau, through a hilly, heavily timbered country, and are using the Bell telephone. At Cape Girardeau our wire passes in on the north side of a window and the wire of the Western Union Telegraph Company passes through the window on the south side, and that is as near as they come together any place on the line. If we listen in the telephone at Jackson we can hear every click made by the W. U. instrument, which is in the same room with the telephone, but in no way connected by wires. The telegraph instrument is secured to a small table and the telephone is fastened on a railing two feet distant.

Jackson, Mo. T. F. WHEELER.

Trueing a Crank Pin.

To the Editor of the Scientific American:

A quicker way of doing the job than that described by J. R., in issue of December 16, is this:

Set the crank shaft perfectly level; place the crank in a horizontal position, and apply a good level to the crank pin bearing. If you have no short level, true up parallel the edges of a strip of wood or metal, a trifle shorter than the crank pin bearing, and wide enough to clear the outside collar of the same; hollow out one of the edges, so that on placing the strip upon the bearing only the ends will touch; put the level on top, file away the high end of the pin till the parallel strip rests level, and by aid of a straight edge carefully file a flat place across the pin. This operation is repeated with the crank in vertical position, and, if you choose, with the same standing at an angle of 45°, both forward and back. With a pair of callipers find the smallest diameter across the flat places, and file the pin opposite to them to that diameter. Use the brasses or a template, the brasses being too large, in filing between the flat places to indicate the high spots, until you have the pin true and round.

I have followed this practice for a good many years with good success, both as to time required to do the work and the truth of it. JAMES LOCHER.

Two Brilliant Meteors.

To the Editor of the Scientific American:

After reading Dr. James' communication to your valuable paper of the 29th inst., I think it very probable that the meteorites in question were distinct, and the dates of observation correct. Within an hour of the time of falling I made a note of the occurrence, from which I wrote my communication to you. Besides, the meteor observed by Dr. James had "a slight deviation to the East," while the one seen by myself had an inclination of 65° to the West.

In regard to the cause of the green color, it may be proper to state that the fact that Dr. Smith, Pugh, Forchhammer, Bergemann and others have observed a fraction of 1 per cent (from 0·03 per cent to 0·45 per cent) of Cu and P, in various meteorites, may lead us to ascribe the phenomenon in question to those elements, although the amount observed be not sufficient to cause the appearance.

Racine, Wis. R. C. HINDLEY.

PRACTICAL MECHANISM.

BY JOSHUA ROSE, M.E.

NEW SERIES—No. XXXVI.

GEAR WHEEL TEETH.

The designations of the various parts of a gear tooth may be understood from Fig. 256, in which A represents the face of a tooth, B the flank, C the point, D the root, E the depth, length, or height, F the breadth, G the thickness, and P P the pitch circle or pitch line, these last two terms being synonymous. When, however, this line is spoken of in connection with a tooth it is termed the pitch line, but with the whole wheel, the pitch circle. The thickness of the tooth is always measured along the pitch line. The distance from the center of one tooth to the center of the next, measured along the pitch line, is termed the pitch, either of the wheel or of the teeth, as the case may be. The distance between one tooth and the next one measured on the pitch line, as at H, is called a space, and is equal to the thickness of the tooth and whatever clearance is allowed. (Clearance will be explained hereafter.)

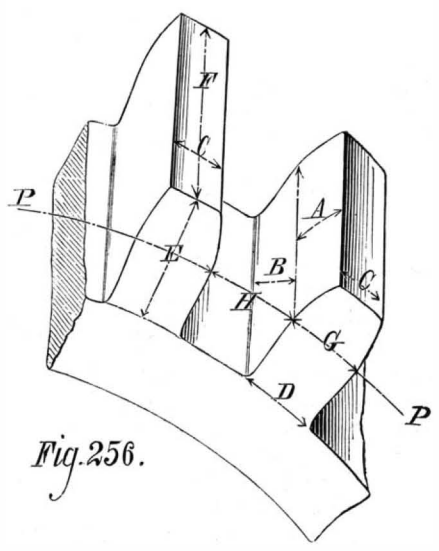

Fig. 256.

The pitch of the teeth may be measured in two ways, one around the circumference of the pitch circle and the other straight across. It is evident that the first is an arc and the other a chord, hence the designations arc pitch and chordial pitch. Suppose that in Fig. 257 P P represents a portion of a pitch circle, and A, B, C, D the centers of teeth, then the distance between two of these centers, measured across E, is the chordial pitch, while that measured around the curvature of P P is the arc pitch. In a wheel having teeth it would be somewhat difficult to practically measure the arc pitch; hence when in the workshop the simple term "pitch" is used, it is understood to imply the chordial pitch, which can

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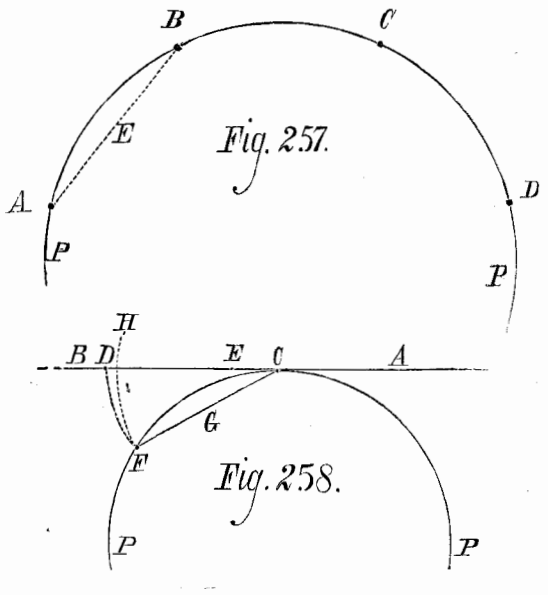
be measured with either a rule or pair of compasses. If it become necessary to obtain the arc pitch, the operator obtains it by calculation. If he is given the diameter of a wheel and the number of teeth it will contain, he divides the circumference by the number of teeth and thus obtains the arc pitch. He then sets his compasses to that pitch, and as a rule steps the compasses around the pitch circle, adjusting them until they mark the pitch circle off into exactly as many divisions as the required number of teeth, and thus obtains the chordial pitch. This, however, is a very delicate operation, since even in a wheel having but few teeth a very small error in the end of the compass points multiplies in the stepping, so that the last step taken will contain the error multiplied by as many times as there are teeth in the wheel. Indeed it is found impracticable to make a very fine adjustment by moving the compass points, and the plan adopted is to rub one side of the points with an oil stone slip, thus saving a great deal of time in the adjusting. To make a similar adjustment with compasses, one side of the pencil point may be eased off either with fine emery paper or a small fine file. It is obvious that the difference between the chordial and arc pitches decreases as the diameter of the wheel or the number of the teeth increases. It is found that in a wheel having 20 teeth it amounts to a little more than the one thousandth part of the radius, and that in a wheel of 40 teeth it is but about one eighth of what it was at 20. On the other hand, in pinions of less than 20 teeth the difference rapidly increases as the number of teeth decreases, and assumes great practical importance. When the number of teeth and the diameter of the wheel are given, we may set the compasses to space off the wheel correctly by the following construction: Let P P, in Fig. 258, be a portion of the pitch circle and A B a line drawn tangent to any part of it (care being taken to draw A B to exactly touch the perimeter of P P). Then from the point of contact (C) of A B with P P, mark off a distance equal to the arc pitch, producing the point D. Mark E = one fourth of C D; and from E as a center, mark the distance E D on P P, producing the point F. A straight line drawn from C to F, as denoted by G, marks the distance for the compass points to be set. Since the least error will make a great difference in spacing around the wheel, the lines must be drawn



very fine, and the measurements made to great exactitude to render this method thoroughly reliable. To show the difference, in the case in point, between the arc and chordial pitches, we may, in this construction, set the compasses to the distance of C F and draw the segment of circle, H; and the distance between the line, H, and the point, D, on the line A B, is the difference in the distance between the points, C F, when measured around the arc pitch and across the chordial pitch. It follows that, the length, C D, equalling the arc pitch, we have by this construction obtained a chordial from an arc pitch.

When the diameter of a gear wheel is given, the measurement is that of the pitch circle; for example, a 10 inch gear is one whose pitch circle is 10 inches in diameter. It is a common practice, however, to give the size of the wheel by specifying the number and pitch of the teeth. In this case, if the arc pitch is given, the mechanic cannot readily measure the pitch accurately, especially is this the case with small pinions having coarse pitches; hence in selecting such a pinion pattern from the pattern loft, he will require to determine the chordial pitch before he can make the selection. If, on the other hand, the chordial pitch and the number of teeth employed to designate the sizes of gears, the diameters will not be exactly proportional to the number of teeth; for instance, a wheel with 20 teeth of 2 inch chordial pitch is not exactly half the diameter of one of 40 teeth and 2 inch chordial pitch, and for this reason it is preferable in using the pitch and number of teeth to denote the size to specify the arc pitch. Another reason is that the arc pitch is obtained by simply dividing the diameter of the pitch circle by the number of teeth, whereas to obtain the chordial pitch requires an abstruse calculation or a drawing, such as shown in Fig. 257.

As a remedy for these defects another and superior method of describing the sizes of gears is employed. It is by the employment of diametral pitch. The theory upon which this method is based is as follows: The diameter of the wheel at the pitch circle is supposed to be divided into as many parts as there are teeth in the wheel, then the length of one of these parts is the diametral pitch. The relationship which the diametral bears to the arc pitch is the same as the diameter to the circumference, hence a diametral pitch which measures 1 inch will accord with an arc pitch of 3·1416; and it becomes evident that, for all arc pitches of less than 3·1416 inches, the corresponding diametral pitch must be expressed in fractions of an inch, as $\frac{1}{1}$, $\frac{1}{2}$, $\frac{1}{4}$ and so on, increasing the denominator until the fraction becomes so small that an arc with which it accords is too fine to be of practical service. The numerators of these fractions being 1, in each case they are in practice discarded, the denominators only being used, so that, instead of saying diametral pitches of $\frac{1}{1}$, $\frac{1}{3}$, or $\frac{1}{4}$, we say diametral pitches of 2, 3, or 4, meaning that there are 2, 3, or 4 teeth on the wheel for every inch in the diameter of the pitch circle.

Suppose now we are given a diametral pitch of 2. To obtain the corresponding arc pitch we divide 3·1416 (the relation of the circumference to the diameter) by 2 (the diametral pitch) and 3·1416 ÷ 2 = 1·57 = the arc pitch in inches and decimal parts of an inch. The reason of this is plain, because, an arc pitch of 3·1416 inches being represented by a diametral pitch of 1, a diametral pitch of $\frac{1}{2}$ (or 2 as it is called) will be one half of 3·1416. The advantage of discarding the numerator is, then, that we avoid the use of fractions and are enabled to find any arc pitch from a given diametral pitch. Examples: Given a 5 diametral pitch; what is the arc pitch? First (using the full fraction $\frac{1}{5}$) we have $\frac{1}{5}$ × 3·1416 = ·628 = the arc pitch. Second (discarding the numerator), we have 3·1416 ÷ 5 = ·628 = arc pitch. If we are given an arc pitch to find a corresponding diametral pitch we again simply divide 3·1416 by the given arc pitch. Example: What is the diametral pitch of a wheel whose arc pitch is $1\frac{1}{2}$ inches? Here 3·1416 ÷ 1·5 = 2·09 = diametral pitch. The reason of this is also plain, for since the arc pitch is to the diametral pitch as the circumference is to the diameter we have: as 3·1416 is to 1, so is 1·5 to the required diametral pitch; then 3·1416 × 1 ÷ 1·5 = 2·09 = required diametral pitch.

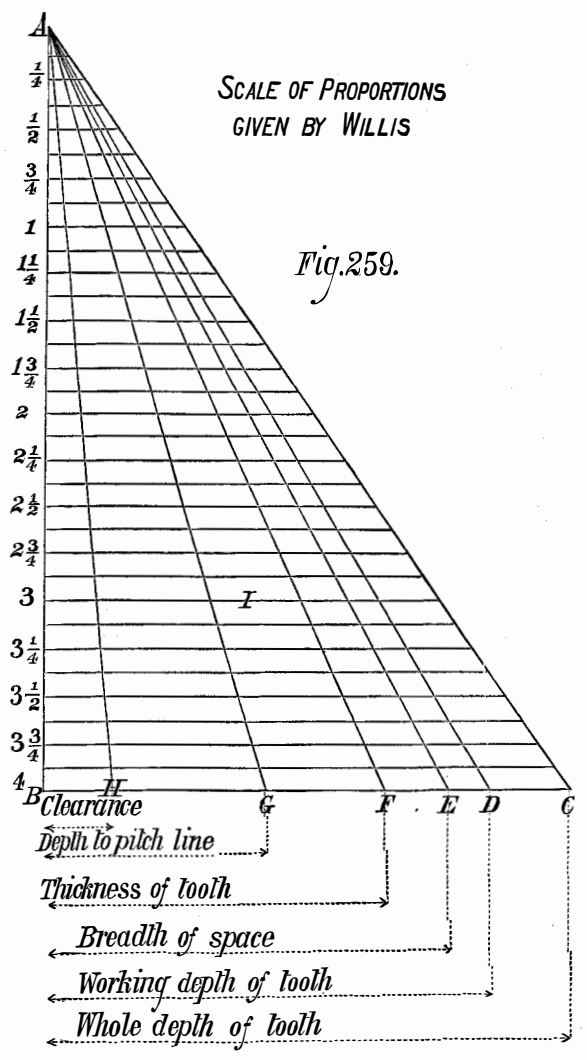
To find the number of teeth contained in a wheel when the diameter and diametral pitch is given, multiply the diameter in inches by the diametral pitch. The product is the answer. Thus, how many teeth in a wheel 36 inches diameter and of 3 diametral pitch? Here 36 × 3 = 108 = the number of teeth sought. Or, per contra, a wheel of 36 inches diameter has 108 teeth. What is the diametral pitch? 108 ÷ 36 = 3 = the diametral pitch. Thus it will be seen that, for determining the relative sizes of wheels, this system is excellent from its simplicity. It also possesses the advantage that, by adding two parts of the diametral pitch to the pitch diameter, the outside or total diameter of the wheel is obtained. For instance, a wheel containing 30 teeth of 10 pitch would be 3 inches diameter on the pitch circle and $3\frac{2}{10}$ outside or total diameter. Below is a table of circular and diametral pitches, which will be found very useful.

Diametral pitch.	Arc pitch.	Arc pitch.	Diametral
2	1·57	1·75 inch.	1·79
2·25	1·39	1·5 "	2·09
2·5	1·25	1·4375 "	2·18
2·75	1·14	1·375 "	2·28
3	1·04	1·3125 "	2·39
3·5	·890	1·25 "	2·51
4	·785	1·1875 "	2·65
5	·628	1·125 "	2·79
6	·523	1·0625 "	2·96
7	·448	1·0000 "	3·14
8	·392	0·9375 "	3·35
9	·350	0·875 "	3·59
10	·314	0·8125 "	3·86
11	·280	0·75 "	4·19
12	·261	0·6875 "	4·57
14	·224	0·625 "	5·03
16	·196	0·5625 "	5·58
18	·174	0·5 "	6·28
20	·157	0·4375 "	7·18
22	·143	0·375 "	8·38
24	·130	0·3125 "	10·06
26	·120	0·25 "	12·56

In using diametral pitch to order wheels it is sufficient to employ two places of decimals; but where mathematical calculations are concerned it is better to use three places of decimals.

It is of but little value to give the size of a wheel to the practical workman or constructor in diametral pitch, because in laying out the wheel teeth he can only deal with either the arc or chordial pitch. He requires the diameter of the wheel and the number of teeth, and then by dividing off the pitch circle into as many equal divisions as there are to be teeth in the wheel, he obtains the arc and the chordial pitches. The length of the arc pitch he can ascertain by dividing the circumference of the pitch circle by the number of teeth, and the length of the chordial pitch he can measure by a standard lineal measuring rule. He has then to proportion the thickness of the tooth, the width of the space, and the height of the tooth, and in doing so the amount of clearance to be allowed must be taken into consideration. By clearance is meant the excess of the width of the space over the thickness of the tooth and the excess of the length of the tooth within the pitch line over its extension beyond the pitch line. The first is usually termed the clearance, and the second the clearance top and bottom. The use of clearances is to allow for imperfections in the workmanship, and is, therefore, made greater in wheels in which the teeth are cast than in those which are cut out by machinery, because wheels cannot be cast so accurately as they can be cut. A wheel moulded from a pattern cannot be so accurately cast as one moulded by a moulding machine, because the pattern is liable to warp, and requires to be well loosened in the mould to enable it to be drawn from the sand without drawing a portion of the sand up with it. When a moulding machine is used the section of pattern used is moved and extracted by mechanical means, and is lifted more truly vertical. By allowing clearance the tooth is proportionately weakened, hence in wheels whose teeth are cut but very little clearance is given, and in the case of involute teeth it is sometimes dispensed with altogether, or made so small as to merely prevent a tooth from contact with both sides of the space of the wheel to which it is geared. Top and bottom clearance is always made somewhat greater than clearance, either in involute or epicycloidal teeth. It follows, then, that the amount of clearance allowed is left largely to the judgment of the designer, and is made to suit the requirements of particular cases.

From the pitch of the teeth all the proportions of the teeth and spaces are designed, and for wheels that have cast teeth Professor Willis gives the following as the proportions generally adopted in practice: Depth from the point of the teeth to pitch line = $\frac{8}{10}$ of the pitch of the teeth; working depth = $\frac{6}{10}$ pitch; whole depth, $\frac{7}{10}$ pitch; thickness of tooth, $\frac{5}{11}$ pitch; breadth of space, $\frac{6}{11}$ pitch. To avoid the trouble of calculating these proportions for every required pitch we may construct a form of diagram which is usually termed a wheel scale, and which being made full size, in Fig. 259, will serve for all teeth up to 4 inches pitch. We first draw the line, A B, making it 4 inches long, and at a right angle to it the line, B C, whose length equals the whole depth of the tooth, which, according to Willis, is $\frac{7}{10}$ of the pitch; and as $\frac{7}{10}$ of 4 inches is $2\frac{8}{10}$, that is the length of B C. We then mark on B C the working depth of the tooth, that is $\frac{6}{10}$ pitch,



the distance from B D equalling $\frac{6}{10}$ of pitch. The breadth of space, B E, = $\frac{6}{11}$ pitch is next marked, and in the same way thickness of tooth, B F, = $\frac{6}{11}$ pitch. Depth to pitch line, B G, = $\frac{3}{10}$ pitch. For clearance top and bottom, $\frac{1}{10}$ pitch = B H is (according to Willis) allowed. From the points C, D, E, F, G, H draw lines meeting at A, and our scale is complete. Now it is evident that, by setting the compass points from B to H, D to G, B to F, B to E, B to D, and B to C, we obtain respectively the clearance, depth to pitch line, thickness of tooth, width of space, etc., etc., for a 4 inch pitch; for any other pitch we have only to take similar measurements on the horizontal line opposite the pitch marked on A B. Suppose then we have a wheel of 3 inch pitch; the full length of the line marked I is the whole depth of tooth, its length from its intersection with A B to its intersection with A D is the working depth of tooth, and so on. By using such a scale liability to error in making calculations is avoided, and furthermore exactitude is assured. Some of the terms given by Willis (whose proportions are almost universally accepted) are in elevenths of an inch, which divisions are not marked upon lineal measuring rules; hence by the trouble of making our correct scale, all future trouble as to these fractional parts of an inch is avoided. It is always best to mark the points C, D, E, F, G, H on the coarsest pitch on the scale, so as to obtain greater accuracy, and in doing so the elevenths of an inch may be obtained by spacing off an inch into eleven divisions, oil-stoning the compass points to make the fine adjustments.

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IMPROVED MARINE ENGINE GOVERNOR.

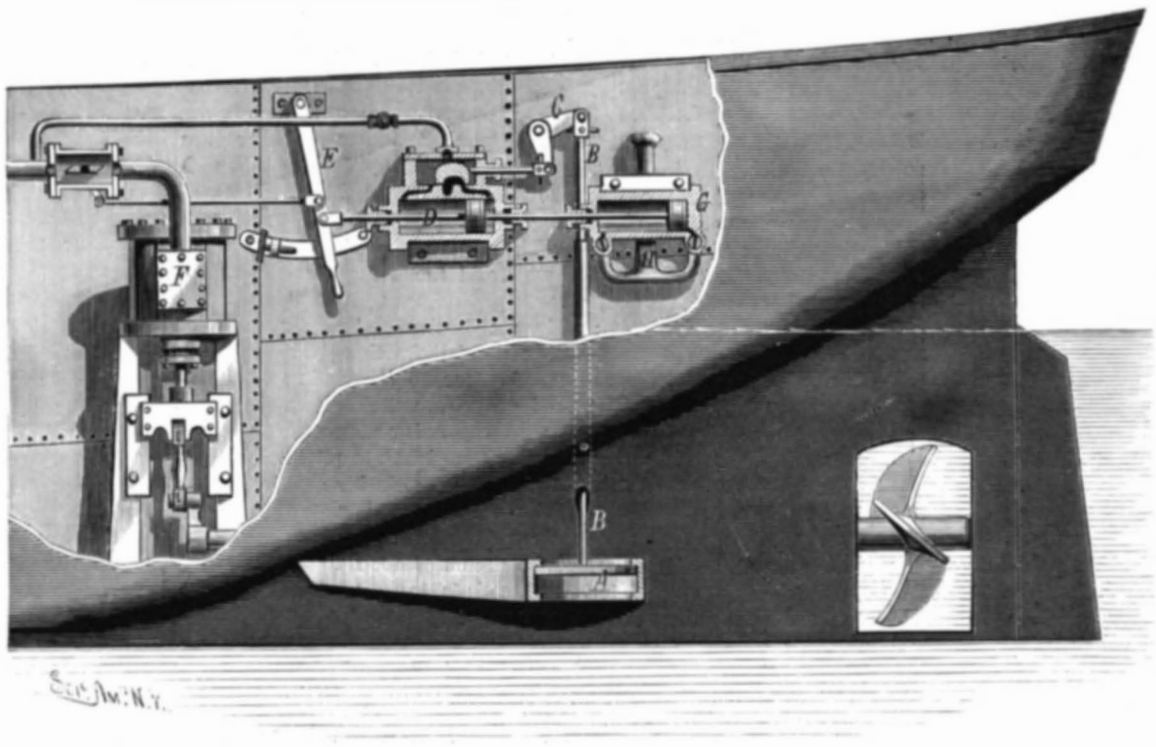
This invention relates to improvements in marine engine governors for the purpose of automatically regulating the speed of the propeller or other driving wheel, as well as that of the engine, when the vessel is exposed to rough seas, in which the propelling wheel is often raised, partly or wholly, out of the water. When this occurs in steam vessels not provided with proper automatic governors, the speed of the engine is dangerously increased if not checked in time by the engineer in charge, causing serious damages to engine shaft and propeller.

The present device is designed to obviate the difficulty, and, unlike most governors for this purpose, it anticipates the movements of the engine, preventing racing and the breaking of the screw blades on their sudden descent into the water. It is also claimed to regulate the engine according as the screw is more or less submerged, a few inches rise or fall of the vessel being sufficient to affect the apparatus.

This invention is constructed as follows: A float, A, is movable in a suitable box, which is situated on the side of the keel but not below it, and about 25 feet forward from the propeller. This box is open in its upper and lower ends so as to allow free access of the sea to the upper and under sides of the float, by which the said float is moved in the box upward and downward, as the propeller is lowered and raised, or, more properly, the float remains stationary in the water during the rise and fall of the open-mouthed box. The latter is provided in its upper and lower ends with an annular flange or stop, so as to prevent the float from ever getting out. To the float is secured an upwardly projecting rod, B, that passes through a tube, and is jointed at its upper end to a knee lever, C, movable around a fulcrum. The other end of said knee lever is jointed to a valve rod that actuates a valve in connection with a small intermediate steam cylinder, D. The forward end of the piston rod of the cylinder is jointed to the ordinary throttle lever, E, or directly to the throttle valve rod if quicker action is desired; said lever is jointed to a throttle valve governing the admission of steam from the main steam pipe to the ordinary valve chest of the steam cylinder, F, of the engine. The small intermediate steam cylinder receives its steam through a pipe leading from the boiler or main steam pipe, and is regulated by a suitable cut-off, or the piston of said cylinder may be actuated by air or gas pressure. The arrangement, as above described, would, in many cases, be sufficient; but, to prevent a too sudden opening and closing of the throttle valve by the fall and rise of the float, in connection with the intermediate steam cylinder aforesaid, there is a pump cylinder, G, the piston rod of which forms an extension of the piston rod of the former, and is movable through stuffing boxes in the usual way. From each end of said pump cylinder leads a small pipe to a stand pipe, H, containing water or other suitable liquid. To allow the liquid to escape gradually from the cylinder through the pipe at each end, there is located a suitable valve or cut-off by which the exit area of the liquid can be effectually controlled and regulated, by which the action of the piston of the intermediate steam cylinder is retarded.

The liquid in the stand pipe is used over and over again, and only a little is wasted by evaporation or leakage.

The operation of this invention is as follows: As the propeller rises upwards, more or less, the float, A, remains stationary till it reaches the lower projection of the open box, which latter moves upward with the vessel and its propeller, and in doing so the rod, B, is moved downward, by which the knee lever, C, is turned around its fulcrum, and thus pushing the valve rod forward lets the steam into the back end of the intermediate steam cylinder, D, of which the piston rod is moved forward. As the latter is connected to the throttle lever, E, it will be seen that the steam is automatically cut off from the main cylinder, F, by the throttle valve; and the lever coming in contact with a set screw can be adjusted to give the valve any desired opening to keep the propeller in a slow motion without letting the engine stop on its center. Now when the piston of the intermediate cylinder, D, moves forward, as described, the pump piston in G must also move forward at the same time, as it is connected to the former by the continuous rod, and the water in the pump cylinder that is before the piston can be expelled therefrom only as fast as it can pass through the small pipe and its valve or cut-off, and thus it will be seen that the speed of closing the throttle valve is easily regulated by opening or closing the valves or cut-offs leading to the stand pipe, H, more or less as may be desired.



FOWLE'S MARINE ENGINE GOVERNOR.

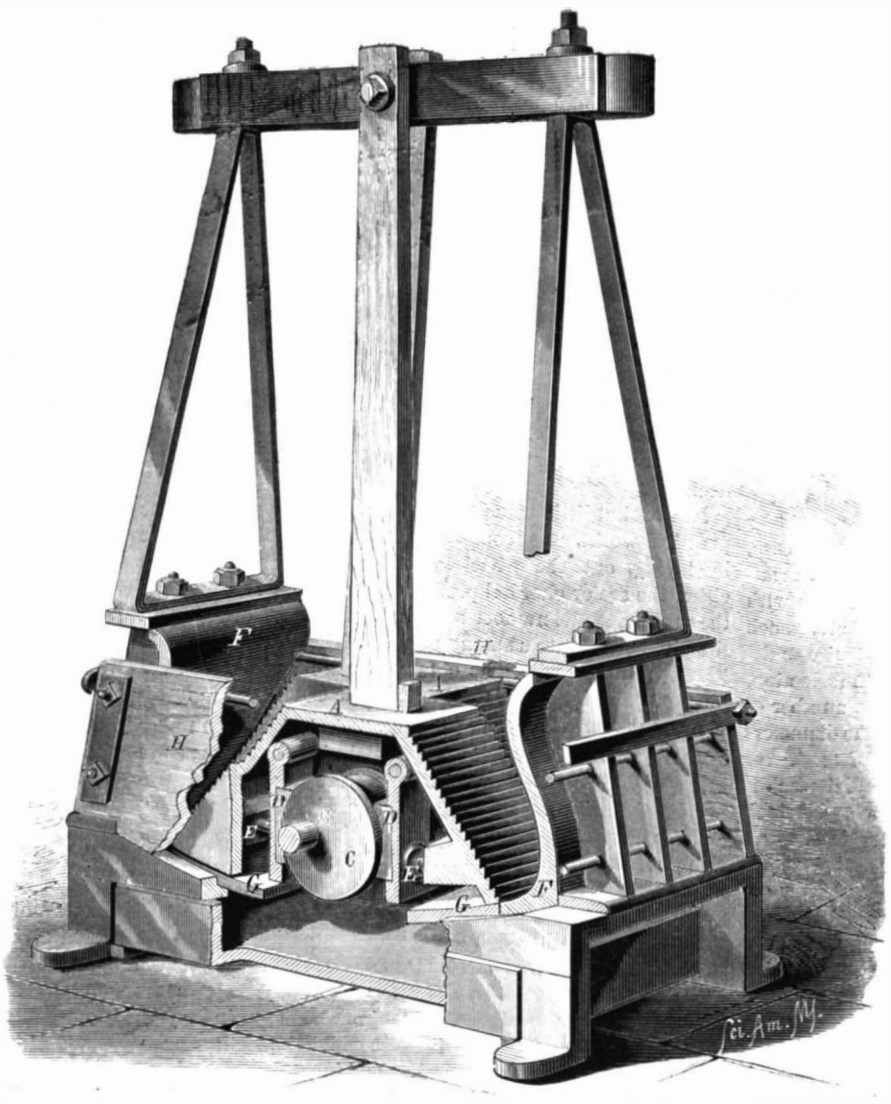
Communications can be addressed to W. H. Ireland, 64 Sudbury street, Boston, Mass.

IMPROVED FULLING MILL.

The advantages of the new construction of fulling mill herewith illustrated, over the ordinary crank and pitman arrangement or falling stock mill, are claimed to be that space is economized, that the mill can be run faster, and that it can be located above the floor without inconvenience. The box and frame are also constructed partially of metal, and thus rendered stronger.

The hammer heads, A, are constructed of metal with a large middle opening, through which the main shaft passes, and in which is an eccentric, C, for working them, said eccentric acts upon bearing pieces, D, pivoted and provided with adjusting screws, E, to take up the wear. The hammer bars are of wood and are pivoted to a wooden cap mounted on a metal frame. The end plates, F, and also the bottom plates, G, are of non-corrosive metal, and the side plates, H, which may be readily changed, are of wood.

We are informed that this mill has been in successful use for two years past. Patented through the Scientific American Patent Agency, April 4, 1876. For further particulars address the inventor, Mr. Joel M. Baldwin, Evans Mills, Jefferson county, N. Y.



BALDWIN'S IMPROVED FULLING MILL.

Seed Adulteration.

There are more stringent laws against adulterations in articles of food or commerce in England than probably in any other country in the world, and there seems to be no lack of energy in their enforcement. Yet it would appear that more adulteration is practised in the United Kingdom than elsewhere. Not content with adulterating the product of the mills the ingenious Briton now sells his countrymen adulterated seed, to such an extent that the dignified *Times* bases thereon a two column editorial, filled with grave remonstrances but chiefly remarkable for utter lack of practical suggestion of how to stop the trouble. Swede seed is adulterated with rape seed, which costs five sixths less. The rape is "killed" by baking in a kiln so that it never comes up to tell tales. Turnip seed is similarly adulterated with charlock. White clover seed is dyed green to imitate alsike, bad and discolored seed is washed and otherwise fixed to look fresh and good. One enterprising German firm, *Iron* says, actually offered in English markets a lot of common sand, which had been treated so that the angles were rubbed off, then dyed, and in short most ingeniously fixed to imitate clover seed. Mr. Henry Bessemer is credited with the suggestion of sprinkling suspected seed on a wet towel and noting what percentage germinates, as a means of testing whether the seed be good or not. Apart from its extreme age, it would be supposed that this idea would occur to any one of average intelligence, without waiting for Mr Bessemer to revamp it.

An Exposition for the Boys.

The Juvenile Industrial Exhibition which it is proposed to hold next year at Ballarat, Australia, under the auspices of the Government of Victoria, seems to us to be worthy of imitation here. It is to be a grand show gotten up with all the paraphernalia of International Exhibitions, but its exhibitors must be under 21 years, or else apprentices not out of their indentures, whatever their age. There are 24 classes covering all kinds of exhibits from machinery to poems, and special prizes are announced. It would be an excellent plan to undertake something of the kind here. To make it a national affair would of course render it too ponderous, but such a show might easily be carried out in a single State The boys often do capital work, and they get little public encouragement, as they are usually employed under other people who absorb the glory to themselves. The boys can invent besides and well, for many have come to this office as applicants for patents. We know also that the SCIENTIFIC AMERICAN finds some of its staunchest supporters and steadiest subscribers among the youngsters. Let us have expositions of what the boys and girls can do, to be held say next summer. It would be a capital winter's work to organize these shows in every township, county or State.

PROFESSOR J.H. KERR, of Colorado College (at Colorado Springs), has discovered some fossils of unusual size in the locality known as the Garden of the Gods, at the foot of Pike's Peak. The length of one of the animals whose remains have been found is estimated at 117 feet. The formation is cretaceous, the bones are easily broken, and the animal figures are in part represented by casts.

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THE CULTIVATION OF CINCHONA.

Cinchona, Peruvian, or Jesuits' bark is the dried bark of many species of the genus *cinchona*, a tree belonging to the order *rubiaceæ* and sub-order *cinchonaceæ*. It grows along the chain of the Andes over a territory of about 2,100 miles in length and from 36 to 54 miles in breadth, extending from Bolivia to New Granada, and is usually found at an altitude between 3,600 and 9,810 feet. The forests in which the tree exists are difficult of access and situated far from the sea. The intervening territory on the Peruvian coast is an arid desert where sand storms are of constant occurrence; but when the forests are reached the total absence of vegetation gives place to tropical luxuriance and the dry hot atmosphere to one that is moist and equable in temperature.

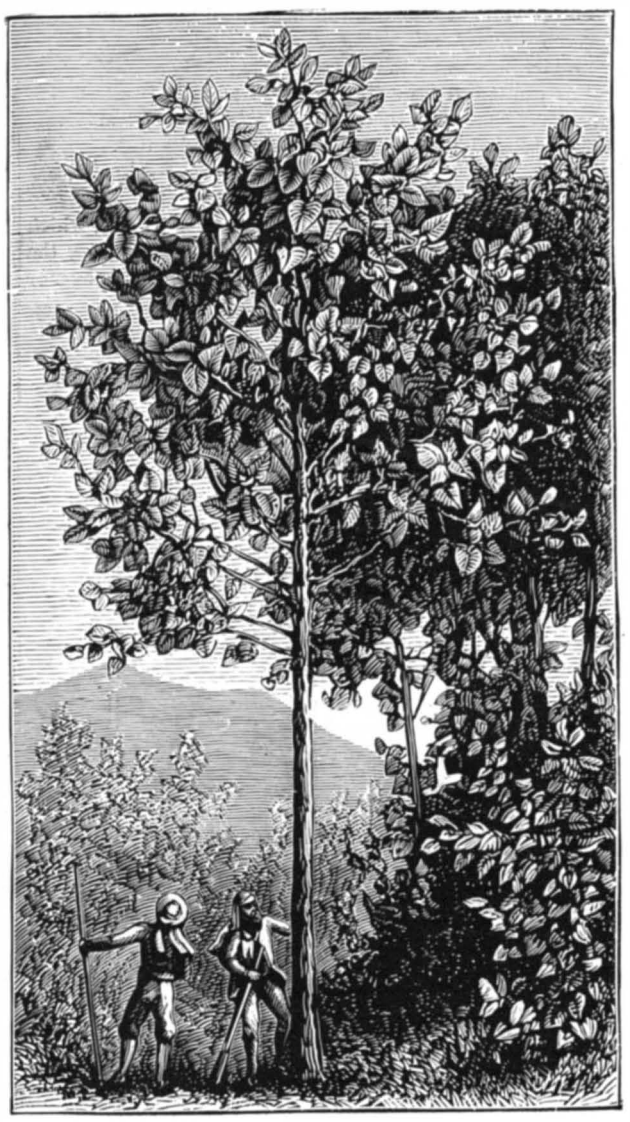
The cinchona tree grows, as shown in Fig. 1, to considerable height. The bark has a silvery exterior, the leaves are large and the flowers white, with rose and purple tints and an odor similar to that of the lilac. To obtain the bark, the "cascarillero," as the gatherer is termed, fells the tree, and with a keen knife makes deep long incisions, so that the outer covering is taken off in strips. These are placed in the sun to dry. If the bark is thin they shrink and roll up, producing the rolled cinchona commercially known. If, on the other hand, the bark is thick, the strips remain flat, and constitute another commercial variety. The various kinds of trees furnish barks possessing especial qualities. Although each species, or even variety, of cinchona may be supposed to produce a separate kind of bark, and although these varieties run into each other in such a way that hardly any two botanists agree as to the proper lines of separation, yet the commercial products may be divided into three classes, yellow, red, and gray barks. To these may be added the non-officinal or Carthagena barks, brought from the northern Atlantic ports of South America.

The medicinal value of Peruvian bark depends upon the alkaloids which it contains. These are quinia, cinchonia, quinidia, cinchonidia, quinicia, and cinchonicia. Another alkaloid, called cincine, is found in small quantities in some of the inferior qualities. It is probable that the three latter alkaloids are artificial derivations from the former. In addition to these the bark contains, in varying proportions, gum, starch, lignine oil, yellow coloring matter, both insoluble and soluble, red coloring matter, kinic and kinovic acids. Quinia, the most important of the alkaloids, is crystallizable, and the sulphate of quinia or quinine is the chief medicament prepared therefrom.

The Dutch and British governments have made successful attempts to introduce the cinchona into their East India possessions, in Java and various parts of Hindostan, where the mountainous regions furnish the necessary temperature and moisture for their growth.

It has been found that the yield of some species of the cinchona in alkaloids may be much increased by covering the bark with moss, and also that a longitudinal strip of bark may each year be taken from a tree without destroying it; the decorticated portion renewing, if "mossed," its former covering, at least as rich in alkaloids as before. Bark from the English plantations has already been introduced into commerce. More or less successful attempts at cinchona culture have been made in Jamaica, the isle of Reunion, Guadaloupe, Brazil, the Azores, and Algeria.

In cultivating cinchona, the care and attention given is greatly repaid in larger proportions of quinia. It is stated that Javan bark has yielded as high as 90 per cent of the sulphate. An excess of azotized matter in the fertilizers used, however, produces an excess of cinchonidine at the expense of quinine. From recent investigations, however, it appears that this is no disadvantage. Dr. Weddell has pointed out that cinchonidine possesses properties as a febrifuge fully as energetic as those of quinine, while it has the advantage of being more easily tolerated by weak stomachs, and of not being so liable to produce intoxication and singing in the head. Trials made by the government of Madras showed that, of 1,145 fever patents, 400 out of 410 who took cinchonidine were cured while the proportions of recovery among those who took quinine were 346 out of 359, and 365 out of 376. This is of considerable importance, as cinchonidine can be obtained much more cheaply than quinine, owing to its being present in the cinchona bark in much larger quantities. It is possible that situations may be found within the limits of the United States suitable for the culture of the cinchonas, so that a new and profitable industry might thus be started.



THE CINCHONA TREE.

CINCHONA FLOWERS.

In our illustrations, which we take from *La Nature*, the cinchona flower is represented separately of natural size. The particular variety illustrated is the *cinchina succirubra*, which produces the red bark and grows chiefly on the western slopes of Chimborazo and the neighborhood.

The National Park.

In the northwestern corner of the territory of Wyoming, bordering on Montana and Idaho, lies a tract of country about fifty-five by sixty-five miles in extent, possessing a greater combination of remarkable features than any other known area of like dimensions under the sun. It contains 3,578 square miles. Its elevation above the sea level is from 6,000 to 14,000 feet. It lies mainly, but not entirely, on the east side of the main range of the Rocky Mountains. By act of Congress, approved March 1, 1872, this tract was withdrawn for ever from sale and set apart as a permanent pleasure ground for the amusement and instruction of the people, under the designation of the Yellowstone National Park. The grandeur and variety of its scenery, the salubrity of its summer climate, and the health-giving qualities of its thermal waters will, within a few years, make it the Mecca of the tourist, pleasure seeker, and invalid from all parts of the civilized world. Among its innumerable attractions are some of the grandest cataracts, cascades, cañons, and mountain summits on the continent. Its spouting geysers, in number and magnitude, exceed all others known. Its numerous mud springs, solfataras, fumeroles, and beautifully terraced hot springs are beyond description in the magnitude and splendor of their decoration and action. The sources of the Columbia, the Colorado, and the Missouri rivers are all said to lie within this pleasure ground of the nations. Its mountain summits are covered with eternal snows, while many of the valleys are made radiant with the sparkle of lakes whose waters are clear as crystal.

The most magnificent of these lakes is the Yellowstone, the source of the river, lying nearly in the central portion of the park. Its form is similar to that of the human hand with the palm to the front and the fingers pointing downward. The altitude of the lake is 7,427 feet above tide water, and its present depth is about 300 feet. It is fed by the snows on the lofty mountains that flank it on all sides. The length of this beautiful sheet of water is about 22 miles, and the width 10 to 15 miles. Professor Hayden declares that there is nothing on the continent that equals it in the brilliant hues of its waters and the splendor of its surroundings. The clear green shading of the mountain slopes, with the ultramarine tint of its shining surface, produce an effect upon the observer which can neither be imagined nor adequately described. The temperature is that of cold spring water. In the early part of the day its surface is usually calm, and its varied hue, from livid green, shading off into a deep ultramarine, presents a picture of beauty that is dazzling to behold. During the later hours a strong wind sometimes arises, stirring the calm lake into all the fury of an ocean storm. The amount of vegetation produced in the depths of Yellowstone Lake is immense, vast ridges of it lining the shores at certain seasons after a high wind has swept over the surface. The only fish found in the lake and in the neighboring streams is the trout, whose numbers are said to be inconceivable. Most of the fishes in the lake are afflicted with the presence in the bodies of a peculiar intestinal worm which, for the time being, renders them unfit for use. The presence of hot springs, with their cones rising above the surface, is a singular fact, the water within the cones being almost boiling hot. Trout have been caught by persons standing upon these cones and cooked in the hot water without being removed from the hook, as declared by the United States Geologist, Professor F. V. Hayden.

But the most wonderful objects of interest in this region are the cataracts and cañons of

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of the Yellowstone, with the spouting geysers in the valley of the Fire Hole river. Neither language nor the painter's genius and skill are adequate to describe either. The lower falls are more than 390 feet high. The walls of the grand cañon are some 2,500 feet in depth, and are colored by hues so various and brilliant that human art despairs of any attempt to reproduce them. "The wealth of red and yellow, brown and orange, pink and green, black, gray, and white fascinates and bewilders every beholder," according to Professor Marshall, "seeming to reproduce before his admiring gaze all the ravished splendors of a very gorgeous sunset, whose charms, no longer evanescent, are here not painted but dyed through and through these mighty cliffs, and made as eternal as the everlasting mountains they buttress." The geysers are even more grand and magnificent, because accompanied by much of the pomp and circumstance of elemental war in the spouting of immense columns of hot water to the height of 90 to 250 feet or more, in the shooting up of vast volumes of steam to an occasional altitude of 1,000 or 1,500 feet, and in the rumbling sound and vibrating motions that accompany the earthquake shock. There are three known geyser basins, but two of which have, however, been explored. These are in the valley of the Fire Hole already referred to, and lie to the westward of Yellowstone Lake, from which they are reached by a tolerably well worn trail. Some of the orifices of the geyser cones are twenty feet in diameter, and during an eruption a column of hot water, filling this orifice, rushes outward and upward with terrific force, and to altitudes varying from 15 to 275 feet in some cases. The cones, rims, and basins formed by the deposits from the springs and geysers are among the most magnificent of their attractions. Many of them have all the beauty of finish and brilliancy of coloring of the finest porcelain, while the waters within the rims and basins of many of the springs are so perfectly transparent that the smallest objects may be seen at the depth of forty or fifty feet.

Our purpose in referring to the park was not so much to attempt a description of its really indescribable wonders, as to call attention to the work of vandalism already inaugurated within it by tourists and visitors. Many of the magnificent structures built up by the action of the hot springs and geysers are being disfigured and destroyed by trophy-hunters and others, actuated, too often it is to be feared, by a pure love of destruction. This shameless raid upon the varied glories of the "Wonderland" should at once be stopped by the strong arm of the law. Congress ought promptly to take such action as will protect and preserve the decorations that Nature for ages past has treasured up among these "everlasting hills," and in the radiant valleys of the upper Yellowstone. A resolution was passed at the recent meeting of the American Association for the Advancement of Science, calling upon our national authorities to act in this matter. It is a subject of quite as much interest to educators as to men of science, inasmuch as the park may be justly regarded as a vast museum whose unlimited resources are capable of illustrating almost every object of thought or subject of study within the range of created existences. Let our educators and friends of education, therefore, add their voices and votes to those of the scientists in the effort to preserve from desecration, and for the high purposes of instruction, the grandest heritage of natural sublimity, beauty, and utility ever bestowed upon man.—*The Educational Weekly.*

WATER HEATER FOR BATHS.

The annexed engravings represent a simple apparatus for heating water for bathing purposes. The heating device, in Fig. 1, is a small stove surmounted by a flue, A B, leading to the chimney. Surrounding the flue and fire chamber is the water reservoir, M N, which communicates with the bath tub faucets. Cold water enters this vessel in the direction of the arrows.

A still simpler construction is shown in Fig. 2. The bath tub communicates by two tubes, R, S, with a cylinder, C, which is filled with water and heated by lamps or a ring of gas burners underneath. In the upper portion of the cylinder is a receptacle for warming towels, linen, etc.

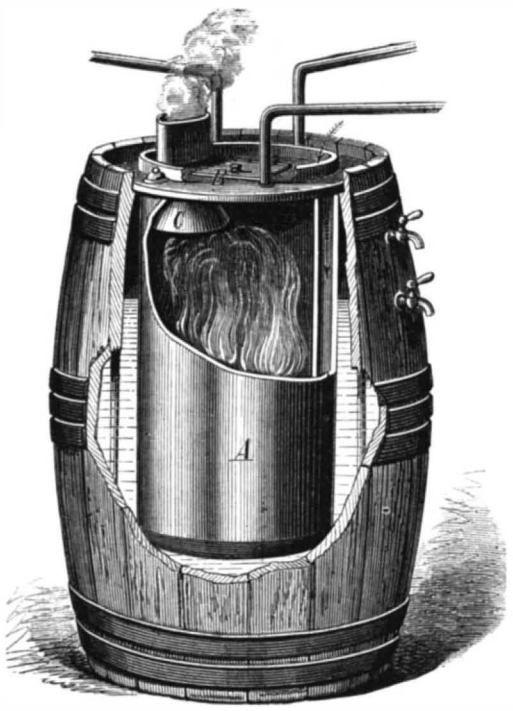
A Blue Printing Process.

The following process, says *Photo. Wochen-Blatt*, may be recommended for printing purposes: Float Saxe or Rive paper for from four to five minutes in a solution of citrate of iron. A tolerably well saturated solution may be obtained by stirring the salt for a considerable time on the boil. The sensitized paper is then dried in the dark, and exposed under the negative till a feeble yellowish trace of the lines of the picture is visible on the paper. In summer five or ten minutes will be found sufficient, and in winter from thirty to fifty for the printing. The prepared side of the paper must be then drawn gently (for a few seconds) over a tolerably strong solution of red prussiate of potash, when with great rapidity there is developed a blue picture, which should be quickly passed through pure spring water, and, if not then sufficiently strong, placed again for several seconds in the above solution, and then for a short time thoroughly well washed. An over-exposed picture develops so quickly that there is hardly time to wash it before the lights begin to tone.

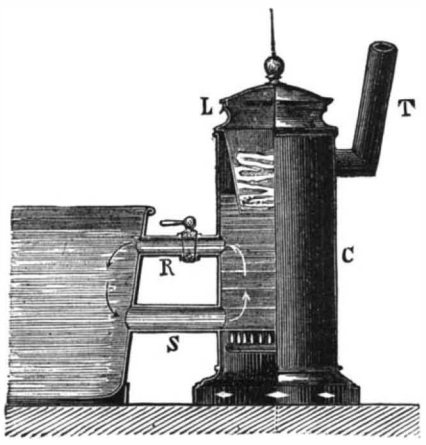
This process of blue printing is of great importance to engravers, who restore by it the stencil for the pantograph. Also for enlargements, wood engraving, etc., it is very useful, and can be worked at a fabulously cheap rate. By washing the picture when finished in water, to which a little ammonia has been added, it will appear more of a violet tint.

A NOVEL STEAM GENERATOR.

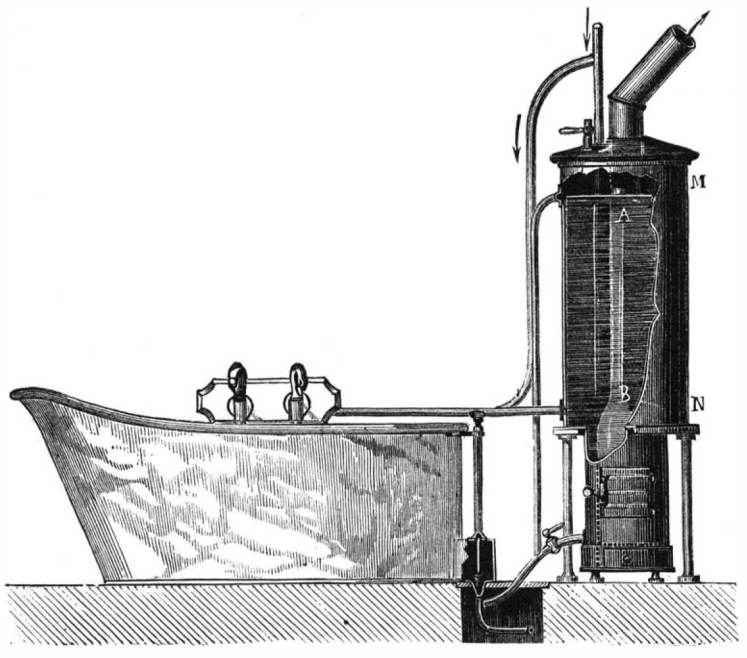
We illustrate a curious method of generating steam, which reverses the ordinary methods, and resembles putting the cart before the horse. Instead of setting the boiler over or



in the fire, the fire is placed over and in the boiler. The barrel in the illustration is cut away to show the interior construction of the generator. A is a sheet iron cylinder closed at both ends and fitted to a cast metal barrel head, B, the lower part being immersed in the water contained in the barrel. A brisk fire is lighted in the cylinder and kept supplied with fresh air by the flue indicated by the arrows.



WATER HEATER FOR BATHS.—Fig. 2.



WATER HEATER FOR BATHS.—Fig. 1.

The funnel, C, acts as a stove pipe. An opening in the barrel head gives access for fuel. The bent pipes shown rising from the barrel carry off the steam generated to any point. Very little heat is thus wasted and a head of steam is quickly secured. This ingenious device was patented through the Scientific American Patent Agency, by T. F. Butterfield. of DeWitt, Iowa.

Astronomical Notes.

BY BERLIN H. WRIGHT.

PENN YAN, N. Y., Saturday, January 19, 1878.

The following calculations are adapted to the latitude of New York city, and are expressed in true or clock time, being for the date given in the caption when not otherwise stated.

PLANETS.

	H.M.		H.M.
Mercury rises	6 08 mo.	Jupiter rises	6 47 mo.
Venus sets	8 18 eve.	Saturn sets	8 55 eve.
Mars in meridian	5 29 eve.	Uranus rises	7 21 eve.
Mars sets	0 04 mo.	Neptune in meridian	6 16 eve.

FIRST MAGNITUDE STARS.

	H.M.		H.M.
Sirius rises	5 42 eve.	Altair sets	6 18 eve.
Procyon rises	5 17 eve.	Fomalhaut sets	6 53 eve.
Regulus rises	7 20 eve.	Algol (2d mg.var) in merid.	7 03 eve.
Spica rises	11 58 eve.	Capella in meridian	9 10 eve.
Arcturus rises	11 00 eve.	7 stars (cluster) in meridian	7 43 eve.
Antares rises	4 08 mo.	Betelgeuse in meridian	9 51 eve.
Aldebaran in meridian	8 32 eve.	Rigel in meridian	9 11 eve.
Vega sets	7 30 eve.		

REMARKS.

Mercury rises 1 h. 13 m. before the sun, and 48′ north of the sunrise point. He will begin to advance, or move eastward among the stars, January 21. Venus is a large crescent. Jupiter rises 34 m. before the sun, and 2° 54′ south of the sun's path. Uranus is approaching Regulus in right ascension, and is now ½° east and 8′ north of the star. Neptune commenced advancing among the stars January 16. Algol will be at minimum brilliancy January 19, 9 h. 23 m., evening; also January 22, 6 h. 12 m., evening; for Washington time, subtract 12 m., for Boston, add 12 m. By an oversight the time of minima, etc., of Algol, last week, was given for Boston. Regulus is occulted by the moon this evening. This is the only bright star occulted this month. It will not be visible north of 16° south latitude. At Rio Janeiro it takes place 1 h. 30 m. after sunset, the moon being ½ hour high, and near the full.

Professor Tyndall on the Development of Bacteria.

Professor Tyndall has recently addressed a letter to Professor Huxley in which he details the results of experiments on the development of bacteria which he thinks settles the question of spontaneous generation, to the destruction of that hypothesis. Fifty flasks containing various organic infusions were sterilized by boiling. Twenty-three were then opened in a hay loft, and the remaining twenty-seven (with special precautions that the air should be uncontaminated by his own presence) were opened by Professor Tyndall on the edge of an Alpine cliff. Both were then placed in a warm room, with the result that twenty-one of the twenty-three flasks opened in the hay loft became speedily filled with organisms, while all the flasks opened on the edge of the precipice remained as clear as distilled water. This furnishes remarkable evidence of the influence of the air on the development of the bacteria, but biologists will hardly acquiesce in Professor Tyndall's rather sanguine assertion until his no less positive opponents, and most especially Dr Bastian, are heard from.

The Oroheliograph.

M. le Commandant de la Noë lately presented a curious looking panoramic instrument to the Photographic Society of France, which he called "Oroheliograph." In a few words, it consists of a camera, the place of the ground glass forming the base, and the lens looking up perpendicularly to the sky. Over the lens is placed a silvered mirror, half globe-shaped, completely circular on its plan and parabolic through its vertical section. The result is that an image of all surrounding objects reflected from this half-ball-shaped mirror is received by the lens always in focus thereon, and transmitted thereby upon the sensitive plate underneath, with its surface forming a right angle with the axis of the lens and circular mirror; by this means a circular panoramic view of the horizon is obtained, as seen from the station the oroheliograph occupies.

The instrument shown to the Society is the first rough model, and the proof exhibited showed some astigmation which would be corrected.

Mr. W. Harrison, in a letter to the *British Journal of Photography*, states that the vertical lines are true and sharper than the horizontal ones; this is caused by the use of a defective reflector silvered on the exterior, which will, however, be obviated. The curves were calculated by Colonel Mangin, of the Engineers. The instrument is considered of value for military reconnaissances, and the angles and heights can be measured from the views taken at two or more stations.

New Tests for Milk.

For the analysis of milk, Professor Lehmann, of Munich, proposes the following: A weighed quantity, say 9 or 10 grammes of milk, is diluted with an equal weight of water, and poured out in a thin layer upon a porous plate of burnt clay, very dense and fine-grained. The water of the milk, as well as the milk sugar, albumen, and a portion of the salts dissolved in it, are absorbed by the clay plate, while the total amounts of fats and casein in the milk

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remain on the plate in the form of a thin skin or film. This film is easily removed with a horn spatula, and then dried and weighed. If it is desired to determine the fats alone, this film may be extracted with ether, and thus the two most important constituents of milk very quickly determined. In many cases it is sufficient to know the total weight of the principal solid constituents of the milk, hence also the amount of water, for which scarcely two hours are required. —*Public Health.*

The Hoosac Tunnel.

This tunnel, near North Adams, Mass., which was completed some time ago so far as to admit the passage of trains, was found to need an extension at the east end in order to prevent the downfall of the rocks upon the track from the cliff at that end of the tunnel. This facade and buttress have just been completed, and the tunnel and track are pronounced in prime order, and ready for all the business which may seek to pass through the great bore. The artificial façade is constructed of granite, some of the blocks weighing from four to five tons each. The arch extension is about 25 feet, and the façade about 60 feet long by 40 feet high.

The Springfield *Republican* says: "Only one track is laid at present in the tunnel. The trains are run by telegraph, passenger trains being allowed ten and freight twenty minutes to pass. Three lights, equidistant, are affixed to the sides of the tunnel, dividing the distance into four sections. The lights are for the purpose of enabling the engineers to regulate their speed, and they are required to maintain a uniform gait the whole distance. At the central shaft two lights are displayed, to indicate when the summit is reached and the grade declines—which it does each way to afford drainage, being sixty feet lower at each portal than at the central shaft. As the trains plunge into the impenetrable darkness the time is recorded, and again when they emerge, by operators situated at either end of the tunnel, and forwarded to the general dispatcher at North Adams. The passage seldom varies a minute. The tunnel is never occupied by two trains at the same time, and no train is allowed to enter until the preceding train has made the exit. No equal distance of the road outside is traversed with so uniform speed, nor with so much safety, the track, which cannot be excelled, being perfectly straight. The roof of the tunnel is considered perfectly safe, not a piece the size of a walnut having been detached for a year, and about a mile and one third of brick arching having been built to sustain all doubtful localities, in sections from ten feet upward. Still, the roof is under constant examination by men on top of an elevated carriage, which is propelled along the road. Admittance to visitors is strictly denied. Occasionally the tunnel is so free from fog and smoke that, standing at the central shaft, daylight can be discerned at both portals, showing about ten feet in diameter, but usually light can be discovered in only one direction, that from which the wind comes, the current driving the smoke before it up the shaft, and leaving the other half of the tunnel motionless and usually dense with smoke and fog. A floor composed of oak, fourteen inches thick, let into grooves cut into the rock on a steep incline, prevents any pieces detached from the sides of the shaft from falling on to the track. At the summit of the mountain the opening of the shaft is inclosed by a stone wall twenty-feet high."

Subsidiary to the great Hoosac Tunnel is that of North Adams, nearly two miles west of the former. This work, too, has just been completed. This is described as a skew arch, and the work is spiral; the abutments are parallel, but not at right angles, crossing the road diagonally. The stones are dressed spirally, and three or four patterns to each individual block had to be furnished the cutters, and no two stones are alike. The continuation of the tunnel is 65 feet in diameter, 26 feet inside of the completed work, with a plain façade of 40 feet high and 50 feet long, and immense wing walls; the coping is surmounted with an iron sidewalk and fence 75 feet long. This structure is a substitute for the dangerous old Furnace Hill bridge.

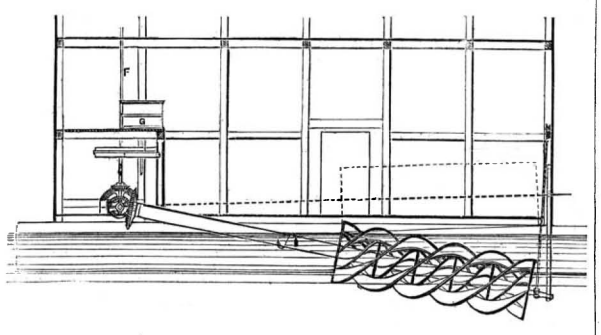
Progress of the Metric System.

At a late meeting of the American Metrological Society Prof. J. E. Hilgard, of Washington, in an address on the "Progress of the Metric System," stated that the United States had not yet been formally constituted a member of the International Bureau of Weights and Measures. The preliminary steps had been taken toward this end, and the matter now rested at the disposal of the Senate Committee on Foreign Relations. The French Commission is busy in preparing the new standards of weight and measure. This is a work requiring extreme accuracy to obtain uniform results. The manipulations are of extreme delicacy. Special apparatus and tools have to be invented and made, and months elapse in their construction. These difficulties will be eventually overcome, and the progress already made is a guarantee that standards of uniformity and accuracy will be made for distribution among the nations which take part in the convention.

In regard to metric standards for the United States, Professor Hilgard said that the standards for separate States had been tendered to each, and were very generally accepted. About thirty States have received their standards and placed them on exhibition in public places where they will be accessible for reference. These standards consist of two metres, a kilogramme, a half kilogramme, a litre and a half-litre. Professor Hilgard mentioned that, when the original iron metre, now eighty years old, was compared with the modern standard, it was found that its difference was less than a thousandth of a millimetre. The trial was made when the iron metre was sixty-seven years old, and it is conclusive in favor of iron for this use, as its changes are so exceedingly small. But a comparison between our standards was less favorable. The iron metre was compared with the standard yard, the latter being of bronze, made to be used at a temperature of 62° Fahr. These differed by the 4000th of an inch, which is a very sensible alteration. Several new methods of making quick approximate comparisons between yards and metres have been considered by Professor Hilgard. Two of these he mentioned. Divide a yard into four equal parts by bisections. Then put together three of the four parts and divide that length into eight parts by bisections. The addition of one of the eight parts to the yard will give a metre within a fraction. Another method, which is preferable on many accounts, is to divide 45 inches into eight parts, seven of which will be a metre very nearly; the 45 inches can be easily obtained by adding a fourth to the yard. It is designed to make the old standards useful by inserting little silver plugs which mark upon them the metrical divisions.

A NEW TIDE MILL.

The annexed engraving exhibits a novel form of ship-mill designed to be driven by tide or current power. It consists simply of a series of spiral wings arranged near the end of, and at an angle of 45° to, a shaft. The outer extremity of the latter is raised or lowered on suitable guides,

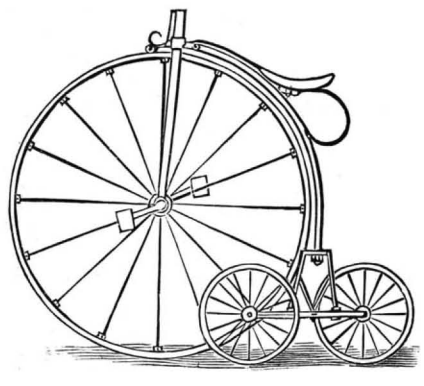


and from the inner one the rotary motion of the shaft is imparted to suitable bevel gearing. The outer end of the shaft is lowered so that an angle of 45° is formed, this being considered as best adapted to allow the screw most advantageously to intercept the passing water.

It will be noted that a second tank or ship for storage of water is here dispensed with, and that by raising or lowering the wheel to a less or greater depth in the water the motion of the driven mechanism can be regulated.

THE DREADNOUGHT TRICYCLE.

We illustrate a new English velocipede, called the Dreadnought Tricycle. The beam or back bone is centered by a slot on to the axle of the back wheels, and is governed by side wheels, so that the back wheels can accommodate themselves to any incline of the road. The driving wheel will thus always be kept upright; and all the strains being removed, the machine can be made as light as any bicycle. Its general construction, as shown by the engraving, is extremely simple, and, besides, the rider can balance himself with



scarcely any difficulty whatever. The English still seem to be much interested in velocipedes, and the improvements in their construction are very numerous. The excitement quickly died out in this country, though it will probably, before long, be again brought over from England. The illustration is from the *English Mechanic.*

Fish Culture.

There are now twenty-seven States whose Commissioners of Fisheries receive, hatch and distribute the eggs of fishes furnished by the United States Fish Commission. About 4,000,000 eggs of California salmon were thus distributed in October. Congress has appropriated $5,000 toward preparing ponds near the Washington Monument for breeding the carp, a European species being regarded as desirable for introduction here. The Wisconsin Fish Commissioners report a large amount of work, having hatched and distributed 1,736,000 lake trout, 6,295,000 whitefish, and smaller amounts of brook trout and California salmon. The question whether our lakes will prove fitted for California salmon will soon be determined. The hatching has been successful with about 90 per cent of the eggs. The Fish Commissioners of Maine report an unusually large quantity of salmon, principally due to the efforts at fish culture, in most of the rivers of the State. Several ponds have been stocked with black bass, as an antidote to pickerel. In the Mattawamkeag River, 80,000 shad fry have been placed.—*Tribune.*

Anti-Fire Construction.*

One of the indispensable requirements of architecture is stability—permanence. And yet of all the buildings ever erected, how few still remain! Even that achievement of engineering skill, the Eddystone Lighthouse, which has bravely resisted the power of the Atlantic for one hundred and twenty years, is at last undermined and must fall. The elements in their unceasing action sooner or later triumph over the proudest works of man. Of the elements at work in this destruction, there is none so active, so successful, as fire. With what fiendish relish does it lick up the combustible, and ruthlessly tumble the residue in shapeless ruin! History teems with its work of desolation. The cities of the Old World have all sadly suffered by its ravages: I will refer to some of them.

GREAT FIRES OF THE WORLD.

The great fire of London, in 1666, burnt for three days, destroying 13,200 houses, including many fine public buildings. The loss by this fire, if computed by present values, would amount to at least $100,000,000.

The city of New York has suffered by at least three great fires. One in 1835 destroyed 600 warehouses, which together with contents were worth $20,000,000. Another in 1839 destroyed property to the amount of $10,000,000; and a third in 1845 destroyed 300 stores and dwellings, valued at $6,000,000. Charleston in 1838 suffered by a fire which destroyed 1,158 buildings, covering 145 acres. Pittsburgh, in 1845, lost by fire 1,000 buildings, valued at $6,000,000. Albany, N. Y., some years since lost in steamboats and buildings $3,000,000. St. Louis, in 1849, lost $3,000,000 in steamboats and buildings. Philadelphia, in 1858, lost 300 houses. In 1845 two thirds of the city of Quebec, comprising 2,800 houses, were swept away by fire. The city of St. John's, Newfoundland, repeatedly damaged by fire, was nearly all destroyed in 1846, when 6,000 people were rendered homeless. Troy suffered severely in 1862. Portland, in 1866, lost $9,000,000, including the loss of 1,600 buildings. Chicago, in 1871, and Boston, in 1872, were devastated to the extent of more than $200,000,000; and quite recently a devastating fire has almost entirely destroyed the city of St. John, N. B. But these marked fires do not alone measure the work of destruction; much is due to the smaller fires, which make up by their frequency what they lack in proportions. Constantly at work, little by little, year by year, the aggregate of ruin they accomplish is fearful.

ANNUAL LOSSES BY FIRES.

A record kept by the New York *Insurance Chronicle* shows that the loss by fire in the United States and Canada in 1876 was $75,000,000, and in the previous year it was $86,000,000. This record is trustworthy, as far as it goes; but I am assured by competent authority that the loss during the last ten years has not been less than $100,000,000 per annum, not including the two extraordinary fires of Chicago and Boston. What a fearful havoc! Is there no remedy?

The losses in the United States and Canada during the last twenty-five years aggregate an amount which would have sufficed to have rendered all the buildings approximately fireproof. A few figures will show this. The United States census for 1870 gives the value of the real estate of the country, but not the value of the buildings alone. This, however, may be approximated. From an estimate made upon the property within certain limits of the city of New York, the value of the buildings was found to exceed considerably the value of the ground built upon. The buildings in the rural districts, however, are of much less value than the land, perhaps not half. A fair average for the two—city and country—would perhaps be one third the value of the real estate. The census for 1876 puts the value of the real estate at about $9,900,000,000, one third of which, $3,300,000,000, then, is the value of the buildings.

This result may be tested by estimates upon another basis. It is shown in the last report of the National Board of Fire Underwriters, page 27, that the insurance effected during the last five years averages about $5,170,000,000 per annum; and it is shown by the records of the New York *Chronicle* that not more than half of the losses by fire are covered by insurance: hence the $5,170,000,000 insured is only half of the insurable property of the country; or, the value of the property of the United States and Canada, liable to loss by fire, is not less than $10,340,000,000. This is the value, not of the buildings alone, but of the buildings and their contents. To ascertain what portion of this is invested in buildings, it is shown by the New York Board of Fire Underwriters in their last report, page 23, that in an average of the losses for the past eighteen years, the portion on buildings was about one third of the whole. Taking this as authority in the matter, one third of $10,340,000,000 is $3,447,000,000 for the value of the buildings in the United States and Canada, which cannot be far from $3,300,000,000 for the United States alone, as before shown.

Of the $100,000,000 annual loss, one third may be taken as that which was invested in buildings; and, had the buildings been of a character to resist the flames, a large part,

* A paper read at the recent Convention of the American Institute of Architects by R. G. Hatfield, F.A.I.A.

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perhaps two thirds, of the loss upon their contents would have been saved: thus ⅓ in buildings and ⅔ of ⅔, or ⅔ of the the contents, or together ⅞ of the whole loss, could have been avoided by having more perfect buildings; or, of the $3,447,000,000 invested in buildings, there is an annual loss of nearly $78,000,000 due to deficiencies in buildings. This is more than two per cent of the value of the buildings, an amount which would in twenty or twenty-five years be ample to render all our buildings approximately fireproof. and would not only save more than three fourths of the present loss in material, but that also which is caused by interruption to business; and, in many instances, avoid the loss of life, and consequent distress to survivors.

LOSS OF LIFE BY FIRES.

Painful instances of loss of life by fire through deficient buildings are still fresh in our memories. The Brooklyn theater and the St. Louis hotel cry aloud for reform in building. Whatever may be said of the inexpediency of expending money upon ordinary buildings to avoid damage by fire, there certainly is no good reason why, at whatever cost, places of public resort should not be made safe. As life is more precious than money, so no money should be considered wasted which is required to protect life. It was lately shown in the Chicago *Investigator*, that no less than 156 theaters have been burned in the United States since the year 1800; and of these 119 were burned since 1850. Similar statements, though perhaps not quite so disastrous, might be made of hotels and other public buildings. The government of a country should be held responsible for life sacrificed in this manner, as well as for that of those who die by neglect of sanitary precautions. The owners of buildings of public resort should be compelled by rigid law to render their property secure from destruction by fire.

COMPARATIVE FIRE-RESISTING QUALITIES OF ORDINARY BUILDING MATERIALS.

In the construction of buildings, the materials most in use are brick, stone, iron, and wood. Brick above all the others is that which possesses fire-resisting qualities in the largest degree. It has been in use from the earliest ages; it is prominent among the materials of ancient buildings. The Pantheon, the only entire ancient building of Rome, is of brick. The marble with which the brick walls were incrusted has long since disappeared. The metal which covered the roof was stripped off for other use. The only opening for light, the eye of the dome, near thirty feet in diameter, has been uncovered, exposing the interior to every storm; and during the nineteen centuries of its existence, it has been subject to repeated conflagrations resulting from the wars which so often desolated Rome; and yet, through all these vicissitudes, the Pantheon still remains in such good condition that it serves as one of the churches of the city. Its durability, however, is due not alone to the character of the material of which it is constructed, but also to its form, the strongest known, a cylinder.

Stone, though inferior to brick, is far superior to iron in its fire-resisting qualities. Granite when exposed to intense heat will crack and splinter freely; marble is quickly reduced to lime; sandstones disintegrate; only those stones which are of volcanic origin may be safely trusted in the fire.

The extensive use of iron as a material of construction is of recent date. Fifty years ago it was but little used. One of the principal reasons for introducing it was its fire-resisting character. Gwilt, in his Encyclopædia, p. 494, art. 1767, edition of 1842, in speaking of iron says, "The security afforded, not only for supporting weight, but against fire, has of late years very much increased the use of it, and may in many cases entirely supersede the use of timber.' The experience of recent years, however, especially at Chicago and Boston, has materially lessened confidence in its fire-resisting character. Indeed, its power to sustain weight when subjected to great heat has been shown to be quite limited. It is capable of sustaining, in an intense fire, neither compressive, tensile, nor transverse strain, to any useful degree. Its untrustworthiness was shown at least two hundred years ago; for Evelyn says of the great fire of London in 1666: "The vast yron chaines of the Cittie streetes, hinges, bars and gates of prisons, were many of them mealted and reduced to cinders by ye vehement heate."

To protect hollow iron columns it has been proposed to secure the passage of a current of air through them. An experiment to test this was made upon a 1½ inch pipe which was subjected to heat at the middle while a strong current of air was maintained through it. It was pulled apart by hand in four minutes after the fire was applied.

All metals transmit heat rapidly—a fact which may account for the rapid loss of strength in iron when subjected to fire. If iron be used for floor beams, arch ties, or for posts, or for any purpose which exposes it to strain of any kind, it should be protected by an incasement of some slow-conducting material, such, for example, as brick, terra-cotta, or gypsum; although this latter material is active in rusting iron, and therefore should not be allowed to come in contact with it. Where gypsum is to be used, a good coat of lime-whiting previously applied to the iron will protect it from the action of the plaster. Mr. Hornblower, architect, of Liverpool, has patented a system of protection to iron beams by means of earthenware jackets and concrete; add Mr. P. B. Wight of Chicago, Fellow of the Institute, has patented a system of protection to iron columns by an enclosure of plaster and other fire-resisting material. These and other systems of protection are just so many concessions to the now well-established fact, the non-fire-resisting character of iron.

PROTECTION OF WOOD FROM FIRE.

Of the four principal materials used in construction, wood is generally supposed to be that which has the least power to resist fire. This idea in general is correct, and yet under certain circumstances wood will resist fire longer than iron. Firemen are reluctant to enter a building on fire when it is known that the supports are of iron, yet do not hesitate where they are of wood. This apprehension of danger from iron supports, the growth of experience, plainly proves the superiority of wood over iron as to a fire-resisting quality.

A floor of wooden beams placed apart in the usual way has but little fire-resisting quality. The fire, aided by a free current of air between the beams, rapidly consumes them as so many pieces of well-placed kindlings. This defect in the construction of wooden floors has led to various devices, one of which is the use of plaster or gypsum, which is thickly spread upon the lathing at the bottom of the opening between the beams, and also extended up on each side. This forms a good filling, effectual in preventing the draught of air: but it has been found to induce rapid decay of the timber, and is therefore a failure.

In the use of ordinary deafening, concrete, plaster, or any similar filling, it is requisite to increase the size of the floor-timbers sufficiently to sustain safely the weight of this filling. The fillings above named are a dead weight upon the floor. If some filling be used which would sustain itself, such, for example, as wood, or if the intervening spaces be filled with so many additional floor-beams, these would not only sustain themselves but would contribute to the general strength of the floor; or, the floor not needing additional strength, the beams could all be reduced in depth to the required limit of strength. An arrangement of this kind produces what is termed a solid timber floor, upon which, there being no interstices for the passage of air, the fire, retarded, acts only in slowly charring the surface. Such a floor would resist the action of fire for many hours, and would be effectual in preventing the spread of it.

But wood is subject to decay; and for this reason is inferior to iron, which is deteriorated by rust generally in a very small degree. Where iron can be protected from injury by fire, it is far superior to wood. For general building purposes, however, wood, if protected from decay, is superior to iron. Our want now is some effectual ready method of preventing decay in wood. Until something better is offered, floor-beams and posts may be subjected to the Kyanizing or to the Burnetizing process, which are claimed to be effectual. It has been proposed, after wood is Kyanized, to coat it with silicate of soda as a protection from fire. Experiments on a large scale in this direction are desirable, and might well be undertaken by the general government at Washington.

Investigations lately made show that the archives of the War Department are exposed to destruction by fire, being lodged in buildings of a frail nature. Self-protection may possibly inspire the authorities to make the indicated tests of wood, from which results may flow of great importance to the country at large.

PRACTICAL SUGGESTIONS IN BUILDING.

In planning buildings to endure, it is required that the walls and partitions, of ample thickness, be made of well-burned brick put together with the best of mortar, and that the floors, as far as practicable, be also made of brick, vaulted. Where this is not practicable, owing to the lateral thrust of the vaulting, then the floors should be of prepared timber laid together solid, and coated beneath with an inch of plastering on wooden lath coated with the silicate of soda; the plaster largely composed of plaster or gypsum. The floor timbers should be attached to each other by spikes or dowels, and lodged at the ends on brick ledges, corbelled out from a good depth below, and secured to the walls with iron anchors. The ends of the beams should be cut inclining, so that while of full length at the lower edge, they will be an inch distant from each wall at the top edge; and this space between the wall and the beams should be kept open for ventilation. The floors at or below the level of the street should always be vaulted with brick: for here it will not be difficult to secure sufficient buttressing to the arches, and here, where the furnaces for heating are located, there is more need of protection. All flues for heating should be of ample size and lined with earthenware pipe. Stairways, usually of wood, afford means for the rapid spread of fire from the lower to the upper stories. Where practicable these should be of brick and stone; and the stairway of each story should be provided with doors by which to isolate it from the other stairways. All partitions should be of brick, especially those about a stairway or an elevator. All shafts for elevators or for light or air should be provided with doors at each floor, in order to cut off when required all opportunity for a current of air. Wooden furring on walls is highly dangerous. Where used it should be provided with bars of filling at proper intervals to prevent draught, and, incidentally, the circulation of vermin. Partition walls of brick should, when possible, take the place of lines of posts and girders, that the apartments may be reduced in size; and the openings in the walls should be provided with doors and shutters by which to isolate the departments.

If buildings were constructed in this manner, a fire would seldom extend beyond the apartment in which it originated.

To protect the exterior, all wooden cornices, dormer windows, and the like should be avoided. Roofs should be of slate or metal laid upon a good bed of cement or concrete. The walls should be extended well above the roof, and coped with stone or iron. The exterior walls should all be of good solid brickwork. If, however, there be iron posts, as those of a store front, they should be filled in solid with brickwork of ample size to carry alone the weight of the upper walls.

Buildings of the character here indicated could be erected at a cost not to exceed fifty per cent additional to that of the average city building, and in a city of such buildings damage by fire would be reduced to a minimum.

New Agricultural Inventions.

Stephen Townsend and John Vickers, of Guysville, Ohio, have patented a Gate Hinge, which is adapted for farm gates which open by first sliding back half their length and then swinging around into a position parallel with the roadway. The pivot and socket portions of the hinge are constructed in such a manner that the former may be detached from the latter when adjusted in a certain position, this position being, however, one which the parts cannot assume so long as the hinge is in use for supporting the gate.

An Apparatus for Applying Poison to Plants, invented by James L. Goodin, of Montgomery, Texas, consists of a tank to receive the poisoned water, and which has a discharge pipe, the inner end of which is provided with a valve. The stem of the valve passes up through a hole in the tank and is pivoted to a lever, which is itself pivoted to a short standard. Three nozzles connected with the discharge pipe distribute the water.

Thomas H. Parvin, of Chicago, Ill., has patented a Lever Take-up for Grain Binders. The invention consists in a lever carrying a sheave, which acts upon the wire or cord, the said lever being connected with another lever that is moved by a cam on the main or other shaft of the binding apparatus. A varied or uniform tension of the wire may thus be secured.

In a Rotary Churn, patented by John W. Hazelrigg, of El Dara, Ill., the upper end of the churn shaft, above the top board, is surrounded by a ring groove, to receive the forked end of a lever, which is slightly bent, and is pivoted at its bend to the top board. By pressing down the rear end, the shaft will be raised and disconnected from the dasher shaft, allowing the hub and the upper end of the dasher shaft to be disconnected and the churn and dashers to be removed.

A Plow, patented by William W. Dawson, of Madisonville, Texas, has the point made with a landside, fitting into a rabbet in the landside of the standard, and made thicker and deeper than the rabbet, so as to project beyond and below the landside to receive the wear. It may be kept in repair at small expense.

A simple improvement on Side Spring Wagons has been invented by Hervey S. Marvin, of Nunda Station, N. Y. The motion of the team and running gear is, by means of two sets of spring bars, not transmitted directly to the driver, but taken up by the lower spring bars and then neutralized by the upper spring bars, so as to give an easy riding motion in passing over obstructions.

A Heel Spur, the invention of George W. Elliott, of Boonsborough, Md. has a reversible rowel, in combination with a shank, which is pivoted to spring jaws, and grooved to receive a tenon formed on the jaws. The spurs can thus be used as blunt or sharp ones.

A Swing invented by Joseph H. Fisher, of Chicago, Ill., has two oppositely arranged half pulleys, over which are placed straps by which the seat and footboard are suspended. The forward oscillation of the swing slightly raises the footboard and lowers the seat, and the backward oscillation produces the opposite effect, the object being to keep the footboard always under the feet.

A Whip Socket patented by George E. Hendey of Waterbury, Conn., is attached to the dasher by lugs which are secured by tapering screws having screw threads upon their smaller ends. The screws secure the socket securely in place and act as wedge keys.

THE Philadelphia *Public Ledger Almanac* has made its ninth annual reappearance, and is brighter and better than ever. Over a hundred thousand are issued.

Inventions Patented in England by Americans.

From November 20 to December 7, inclusive.

BALING COTTON.—Leslie Belden.
BRICK KILNS.—Wm. T. Christy, St. Louis, Mo.
BROADCAST SOWERS.—David Buist *et al.*, Philadelphia, Pa.
CIGAR LIGHTER.—J. A. Chandor, New York city.
CIGARS AND CIGARETTES.—T. H. Babcock *et al.*, Brooklyn, N. Y.
COMBINED TAP AND FAUCET.—Amasa Mason, New York city.
DENTAL CHAIRS.—Basil M. Wilkerson, Baltimore, Md.
EDUCATIONAL APPLIANCES.—W. W. Rose, New York city.
FLOWER VASES AND BOXES.—C. H. Crater, Oswego, N. Y.
GYMNASIUM APPARATUS.—J. A. Chandor, New York city.
LAMP BURNERS.—Francis Holt, Newark, N. J.
METAL-REDUCING MACHINE.—G. J. Capewell, Chesire, Conn.
MOWING AND REAPING MACHINES.—W. A. Wood, Hoosick Falls, N Y.
MUSICAL INSTRUMENTS.—E. P. Needham, New York city.
PAPER BAG MACHINE.—G. H. Mallary, New York city.
PEN RULING MACHINE.—W. U. Hickok, Harrisburg, Pa.
PIPE JOINTS.—William Painter, Baltimore, Md.
POTATO DIGGER.—Lewis A. Aspinwall, Albany, N. Y.
RAILROAD AIR BRAKE.—William Stevens, New York city.
SAFETY PINS.—Purches Miles, Brooklyn, N. Y.
SCOURING AND POLISHING GRAIN.—J. M. Galt, Sterling, Ill.
SEWING MACHINE ATTACHMENT.—D. M. Somers, New York city.
SHARPENING FILES.—B. C. Tilghman, Philadelphia, Pa.
TELEPHONE WIRES.—Alexander Graham Bell, Boston, Mass.
VENTILATING GLASS SHADES.—S. J. Pardassus, New York city.
WEARING APPAREL, LEATHER.—Richard Lazenby, New York city.

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Business and Personal.

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Diamond Planers. J. Dickinson, 64 Nassau St., N. Y.

Shaw's Mercury Gauges, U. S. Standard of Pressure. 915 Ridge Ave., Philadelphia, Pa.

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For Town & Village use, Comb'd Hand Fire Engine & Hose Carriage, $350. Forsaith & Co., Manchester, N. H.

John T. Noye & Son, Buffalo, N. Y., are Manufacturers of Burr Mill Stones and Flour Mill Machinery of all kinds, and dealers in Dufour & Co.'s Bolting Cloth. Send for large illustrated catalogue.

Power & Foot Presses, Ferracute Co., Bridgeton, N. J.

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Steel Castings from one lb. to five thousand lbs. Invaluable for strength and durability. Circulars free. Pittsburgh Steel Casting Co., Pittsburgh, Pa.

For Best Presses, Dies, and Fruit Can Tools, Bliss & Williams, cor. of Plymouth and Jay Sts., Brooklyn, N.Y.

Hydraulic Presses and Jacks, new and second hand. Lathes and Machinery for Polishing and Buffing metals. E. Lyon & Co., 470 Grand St., N. Y.

Corliss Engine Builders, with Wetherill's improvements, Engineers, Machinists, Iron Founders, and Boiler Makers. Robt. Wetherill & Co., Chester, Pa.

C. C. Phillips, 4,048 Girard Ave., West Phila., manufactures Vertical and other Burr Mills adapted to all kinds of grinding; also Portable Flouring Mills.

Magic Lanterns, Sciopticons, Stereopticons and Views. The best at lowest prices. Illustrated catalogue, 140 pages, 10 cts. Second-hand catalogue, 10 cts. Circulars free. Theo. J. Harbach, 809 Filbert St., Philadelphia, Pa.

Friction Clutches warranted to save Rolling Mill Machinery from breaking. Also Hoisting Machines and Safety Elevators. D. Frisbie & Co., New Haven, Conn.

For Sale.—An Elevator, with Carriage, suitable for a Hotel. Apply to Morgan & Co., 154 South 4th St., Philadelphia, Pa.

For Solid Wrought Iron Beams, etc., see advertisement. Address Union Iron Mills, Pittsburgh, Pa., for lithograph, etc.

Felt of every description for Manufacturers' purposes, especially adapted for Polishing, can be furnished in any thickness, size, or shape. Tingue, House & Co., Manufacturers. Salesroom, 69 Duane St., N. Y. Factory at Glenville, Conn.

Improved Wood-working Machinery made by Walker Bros., 73 and 75 Laurel St., Philadelphia, Pa.

Bound Volumes of the Scientific American.—I have on hand about 200 bound volumes of the Scientific American, which I will sell (singly or together) at $1 each, to be sent by express. See advertisement on page 29. John Edwards, P. O. Box 773, N. Y.

Ice Machines. Clayton & Cook, Daretown, N. J.

Skinner Portable Engine Improved, 2 1-2 to 10 H. P. Skinner & Wood, Erie, Pa.

Best Machinists' Tools. Pratt & Whitney, Hartford, Ct.

Lansdell & Leng's Lever and Cam Gate Valves. Cheapest and best. Leng & Ogden, 212 Pearl St., N. Y.

More than twelve thousand crank shafts made by Chester Steel Castings Co. now running; 8 year's constant use prove them stronger and more durable than wrought iron. See advertisement, page 46.

For the best Bone Mill and Mineral Crushing Machines, address Baugh & Sons, Philadelphia, Pa.

Vertical Scientific Grain Mills. A.W.Straub & Co., Phila.

AN ASTONISHING OFFER.

THE INDEPENDENT, of New York, offers in another column to give away, absolutely, a Worcester's Unabridged Quarto Pictorial Dictionary, which retails everywhere for $10, and is, of course, a household necessity. How they can do it is, we must confess, a mystery; but that they do there is no question.

THE INDEPENDENT is now publishing REV. JOSEPH COOK'S famous Boston Monday Lectures, which are creating so much discussion everywhere.

See advertisement of THE INDEPENDENT in this paper.

Notes & Queries

(1) C. C. P. asks: In boiling linseed oil by means of a coil of steam pipe placed in the oil vat and connected with an ordinary flue, would it be necessary to superheat the steam? A. It will be advisable to superheat the steam, as the pressure of saturated steam due to the required temperature is very high.

(2) A. J. H. asks for a recipe for making marking ink that does not contain anything having a tendency to dissolve rubber? A. Lampblack or bone-black thoroughly ground with good soap and a very little dilute glycerin gives satisfaction. Shellac dissolved in strong aqueous solution of borax may also be used as a vehicle. For fine work, soluble aniline black dissolved in hot dilute glycerin is preferred.

(3) O. A. asks: Is there some cheap way that I can regulate my baking oven automatically when it gets heated to about 300°? A. We do not recall any means to do this better than by a thermometer, having its column of mercury in an electric circuit; so that the circuit will be closed by the mercury when the column reaches the height of 300°, and whereby an electro-magnet will be caused to attract an armature secured to the lever of a damper.

(4) A. F. W. says that he has been told that those who subsist almost wholly on a vegetable diet are liable to lose their mental power and vigor in old age. A. We do not think that there is any very good foundation for this statement.

How great an atmospheric pressure can a man of average power accustom himself to exercise in moderately? A. The precise limit at which men can work has probably never been definitely ascertained, while at the same time it is doubtful whether work can be carried on under any increase of pressure without danger of injury to the physical system.

(5) H. A. Z. asks (1) how to combine an oil with powdered black lead so as to make a black lead lubricator? A. The best way is to grind the clean substance with the oil. 2. What kind of oil could be most effectually used and with combined cheapness? A. A good quality of rosin oil would perhaps answer best.

(6) R. J. F. asks: 1. Where can I find the best description of an electrical engine? A. See p. 184 of our issue of September 22, 1877. 2. Is Bell's telephone patented? A. Yes. 3. What is the electrical candle? A. See p. 1366 of our issue of the SUPPLEMENT, August 25, 1877. 4. In making an electric light, would not 2 or 3 large gravity cells, attached to a Ruhmkorff coil of medium size, answer the purpose and give as good results as a battery of from 60 to 100 cells of Grove's set up in the intensity way? A. Not by any means known of at present, although the use of the Ruhmkorff coil, as a means to furnish light, is being closely studied.

(7) M. I. wishes to know the proper speed for a 55 inch circular saw cutting white pine, and the proper time to gauge the speed, whether when cutting or when running light? A. You can run the saw, when in the cut, 650 revolutions a minute.

Also, having previously used a 10 foot pipe for conducting steam from boiler to steam engine, what loss of power will be experienced by using a pipe 20 feet in length? A. If the steam pipe is unprotected there will be more loss from radiation when the length is increased. But if the pipe is large enough (which we cannot determine from the data sent) and is well fitted, the change will make no material difference.

Also a recipe for a liquid in which to place pens after using, to prevent their clogging with ink, said liquid to take the place of a pen stand and penwiper? A. Probably water will do as well as any other liquid.

(8) H. A. S. asks for a rule to find the required diameter of a shaft where the length of shaft, number of revolutions per minute, and number of horse power to be transmitted is known? A. Let P = pressure in lbs. per square inch acting with an arm of a inches, then the diameter in inches $= 0{\cdot}0934 \times \sqrt[3]{P \times a}$

(9) W. M. asks: 1. What can I polish zinc stove boards with, to remove the dullness? A. Fine sand moistened with very dilute sulphuric acid (1 part acid to 20 of water). 2. Is there anything better than oxalic acid for cleaning copper boilers? A. Try dilute hydrochloric acid. Grease must be first removed with a sal soda solution.

(10) J. P. P. writes: 1. You say in your "Answers to Correspondents," in the issue of December 22, 1877, p. 396, answer 49, that 4 ozs. of copper wire is the amount to use for a pair of telephones. I judge by that you mean the wire wound on the spools at one end of the magnet. I bought 1 oz. of No. 36 insulated copper wire of an electrician, who said that it was sufficient for a pair. Is it impossible to obtain successful results with that amount? Must it be wound in the same direction on both magnets? A. The answer you mention refers to the small instrument in common use described on p. 207 of our issue of October 6, 1877, in which there is but one round bar magnet to each instrument, and one spool on each magnet; and the answer refers to the amount of wire to be used on the two separate instruments shown in Fig. 1, which would be 2 ozs. of insulated wire (of between No. 36 and 40 gauge) for the spool of one machine made on that plan: and this amount will give a good result, although the instrument may with care be made to work with less. Wind each spool in the same direction. 2. Must the ends of the magnets on which the wire is wound be north and south poles, or both similar? A. In the description referred to, the spool end of the magnet of each instrument is of north polarity. 3. I have been told that successful results depend greatly on the nicety with which the distance between the iron plate and magnet is adjusted. Is this so? If not, at what distance should the magnet be set to obtain good results? A. When the bar magnet in this style of instrument is once set at a proper distance (about $\frac{1}{32}$ inch) from the iron membrane, it need not be altered unless the membrane is accidentally bruised. 4. How thin must the iron diaphragm be, and what diameter? A. About $\frac{1}{100}$ of an inch thick, and of about the diameter shown in Fig. 1. 5. I am using a tin-type plate and it is coated with some preparation. Would that make any difference in the vibrations? A. If not too heavy it may be left on (without causing any material interference with the vibration), as it serves to preserve the membrane from rust.

(11) W. V. asks: What is the horse power of the largest locomotive ever constructed? The steamship City of Washington has two engines, which are rated over 2,000 horse power. A. We do not think that experiments have ever been made to determine the power actually exerted by the largest locomotive, but the "Janus," with four cylinders, each 15 x 22, is probably capable of higher power than that quoted by you.

(12) E. H. B. writes: 1. I wish to get a battery for experimental purposes; will you inform me whether the Grove or Bunsen battery is considered the best? A. The Grove battery is generally preferred on account of the durability of the platina strip, which forms its positive pole. 2. Which is the best for an electro-magnet, a long coil of fine wire or the reverse? I shall use about three cells of battery and want to make as powerful a magnet as possible. A. The wire should be of such size and length that its resistance will equal the resistance of the battery. Three lbs. of No. 30 copper wire (cotton or silk insulation) is sufficient, if properly wound, to make a good electro-magnet using the battery power you mention.

(13) C. S. writes: 1. Will you please inform me what the difference is between a high and low pressure steam engine? A. The first exhausts its steam into and against the pressure of the atmosphere; the second exhausts into a partial vacuum produced by the condensation of its own steam. 2. For what purpose are the high and low pressure steam cylinders in a compound engine? A. For the purpose of obtaining more work from steam of a high pressure.

(14) H. R. T. & Co. write: We pass our exhaust steam through a copper pipe to heat our liquors. Is it safe to use the water again in the boiler of the steam so condensed, or has it received properties from its contact with the copper pipe and also with the grease (tallow) used in oiling the cylinder, that would make it injurious to the boiler? If not this would give us clear water free from lime deposit, as our exhaust is wholly condensed. A. It is safe, provided you can be sure that your copper pipes will not leak, so as to contaminate your condensed water with the liquors through which they pass. Allow your condensed water to run into a tank, so that there will always be a surplus of water, on the surface of which, whatever tallow there may be carried over, will float; and if the water in the tank is three feet deep, draw your feed water from a point one foot from the bottom of the tank. You will notice that the tallow is deposited in the exhaust pipes in which the steam condenses, and it would be well to place an ordinary sink trap (which any plumber can furnish) at that point in the exhaust pipes where the tallow accumulates.

(15) L. N. B. writes that he has a stream running through his land, the water being 2 feet deep and 20 feet wide; the current runs 200 feet a minute. What kind of wheel, he asks, can he use without a dam to work a threshing machine? A. What is called a current wheel will answer. It is very similar to the paddle wheel of a steamboat.

(16) C. R. A. asks: 1. If there exists a law in Pennsylvania requiring steam boilers to be inspected? Or a law prohibiting the hanging of extra weights on safety valves, such as shovels, pokers, tongs, etc.? A. We think not, but we are not very familiar with Pennsylvania laws. Some of our readers will please correct us if in error. 2. How often should a boiler be cleaned out that fills up from 1½ to 2 feet with loose scale in the course of six months? A. Every week.

Should the stopcock be opened at a gas well, allowing the gas to escape without closing valve at furnace, and is there a possibility of the fire coming through gasoline and setting fire to gas at the well? A. Ordinarily, no.

How can I prevent polished brass from coloring where it is heated by steam? A. Give it a coat of transparent varnish.

(17) I. H. C. writes: A steam engineer, friend of mine, is making a test gauge, and claims that a square inch when thrown into a circle the diameter would be 1·25 inches, and undertook to prove it to me by taking a strip of tin 4 inches in length and showing that it just meets around a mandrel of that size. A. The area of a circle is found by multiplying its diameter by the decimal ·7854; and conversely, the diameter will equal the area divided by ·7854. In the case you mention the area of the circle is 1 square inch, and its diameter is therefore 1·273 of an inch.

(18) C. G. asks: Is there any machine by which the nose can be straightened? A. There is a mechanical appliance in the market, but we cannot say whether or not it is generally efficacious. You can probably obtain the apparatus at a store where surgical instruments are used.

What is the cause of the following? When I place a finger over either ear so as to close it, I am able to sing several notes higher and louder than usual. A. If this is a fact, we must ask some of our readers to aid us in giving an explanation. When one ear is closed, as indicated, a given sound is greatly changed, according to the sensation of the one-eared listener.

(19) D. F. H. asks: How large a battery and what kind is used in transmitting messages by the Atlantic cable? A. The Atlantic cable may be operated by a battery that could be placed in a thimble.

(20) W. R. B. says that the sponges used at the Aquarium become clogged with dirt and slime and are difficult to clean. Is there any method of cleaning them readily and thoroughly? A. The Barbary sponges are often difficult to clean perfectly by any direct means applicable. Hot water and plenty of good soap are among the best things. Adhering lichen is softened considerably by digestion in dilute H_2SO_4 (1 to 30). Neutral ammon. chloride used hot also works pretty well. Alkalies, even quite dilute, quickly clean such fibers, but are too apt to deprive them of native stiffness.

(21) A. M. W. says: 1. I have an engine with a 3½ inch stroke and 3½ inch bore. What size boiler, number of flues, and amount of heating surface, also diameter of flues, will it require to run it 400 revolutions, working at its full capacity? A. Make a boiler 30 inches in diameter, 4 feet high, with about 80 square feet of heating surface. Tubes 2½ inches diameter. 2. Also what size boat would it run 8 miles an hour, drawing not over 10 inches when loaded? What diameter and what pitch would the propeller have to be? A. We doubt the practicability of realizing this speed, if, as we understand you, the propeller is to conform to the draught.

(22) G. T. L. writes: In the use of the metric system of weights and measures in French machine shops, how are the threads of screws reckoned, at so many threads per meter, per decimeter, per centimeter, or how? A. The number of threads are referred to the diameter, that is, so many threads per diameter. For example, 5 threads per diameter of 6·3 millimeters is about the same as the American proportions for a ¼ inch thread, 20 threads per inch.

(23) J. H. F. asks: Which will work with the least power, a 2 inch crank or an eccentric, to drive a pump in a well 100 feet deep? A. The crank, as its use involves less friction than there is apt to be in the use of the eccentric. On account of its large bearing the eccentric motion is valuable in those cases (as in presses for cutting metal) where a powerful motion is required through a short distance. 2. What is the number of lbs. pressure per square inch at 50 feet and 100 feet? A. A column of water 32 feet high and 1 inch square weighs about 15 lbs.: that is, it will about balance the pressure of the atmosphere on a square inch of surface, at the level of the sea.

(24) N. A. S. writes: 1. Can I light gas by a plate machine (frictional electricity)? A. Yes. 2. If so, about how large a plate would be required to light about 24 burners? A. The glass plate of the machine should be about 18 inches in diameter, and its electricity should be accumulated in a Leyden jar battery of about 28 square feet of surface. 3. Are the wires over the jets left in the gas flame during the time it is burning? A. Yes. 4. How far apart should the points be? A. About $\frac{3}{16}$ of an inch.

(25) E. U. N. asks: How can I make a really good razor strop paste? A. Equal parts of jeweler's rouge, plumbago, and suet melted together and stirred until cold.

At what depth in the ocean does the water become calm in all weathers, or is the whole mass of the ocean affected in rough weather in a similar manner to the surface? A. Water is agitated in the ocean only to a depth equal to the height of the waves.

What is the greatest extent to which air (atmospheric) has been compressed, and was any effect observable beyond diminution in bulk? A. It has been compressed to several hundred atmospheres without apparent change.

(26) I. H. B. asks (1) how the telephone is made, and what paper has a cut of it? A. The telephone is described in our issue of the SCIENTIFIC AMERICAN of October 6, 1877. 2. How do you prepare insulated wire? A. The wire is covered with silk or cotton, by means of a machine shown on p. 130, Fig. 4, of our issue of September 1, 1877.

(27) H. G. E. asks: 1. What is the difference between No. 1 and No. 2 pig iron? A. No. 2 is the hardest. 2. How can you tell the difference? A. No. 2 is closer grained than No. 1. 3. What is meant by the term hot iron? A. We presume it refers to iron made by the hot blast. 4. What is "gray forge iron" and how told? A. It is a grade of gray iron suitable for conversion into malleable iron, and is distinguished by the color of the fracture.

(28) I. G. writes: 1. I am making a telegraph sounder; the cores are 2 inches long and ⅜ inch in diameter. On one end of each core there is ¼ inch with a thread on to fasten to back armature; said armature is ⅜ inch thick. I intend to put a piece of gutta percha ⅛ inch thick against armature and one of same size at top of core, which will leave 1½ inch for wire to be wrapped on. I want an instrument so that I can use it on lines of 1 to 15 miles, also to give strong clicks. Please inform me what sized wire I shall use, how much on each spool, and kind of insulation? A. Wrap the core with one layer of paper, and on this wind covered copper wire of about No. 27 Brown and Sharp's gauge, until the spool is about 1⅛ inch in diameter. 2. Shall I wind both magnets to the right, or both to the left, or one to the right and the other to the left? A. Wind both spools the same way. 3. Shall I strip the end of wire for a couple of wraps on core? A. No. 4. If four such as the above instruments were on a line of 100 yards, how many cells of gravity battery would it take to work them? A. About 4 cells.

(29) P. R. asks. Would it be of value to invent a mode of making curves and coils of pipes out of tin, or sheet metal generally? A. A cheap method of making such curves (especially for lead traps) has long been sought.

(30) H. L. asks: On what principle does the injector work? A. It is supposed to act somewhat on the same principle as the hydraulic ram, whereby the momentum of a large column of water is imparted to a smaller one. A column of steam moving at a high rate of speed is condensed by cold, so as to have a much smaller diameter, and, having the full momentum of the original (continuous) column of steam, has more penetrative power, so to speak, and carries the water into the boiler by the friction of its column against the water with which it is surrounded.

(31) I. G. writes: I have made a tap two inches in diameter from what I supposed to be tool steel, but after finishing discovered that it was machinery steel. By what process can I harden it so that it will stand? A. Heat it well hot in a mixture of equal quantities of cyanide of potash and salt, and dip in water containing 1 lb. of salt per gallon.

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(32) I. P. H. asks how to manufacture the gas and inflate some 3 or 4 dozen rubber toy balloons? A. Place a few ounces of clean scrap zinc in a stout half gallon bottle and pour over it a cooled mixture of 1 part oil of vitriol and 5 parts water. Stop the mouth of the bottle with a rubber stopper through which has been fixed a short piece of glass tubing of size suited to fit the mouth of the balloon. Exhaust the bag of air and tie it on the glass tube. When sufficiently dilated tie the mouth with thread and flow the dilated bag with a thin alcoholic solution of colored wax, collodion, or resin.

(33) E. J. S. asks how to preserve the feet and external parts of stuffed animals? A. Dissolve about ½ oz. corrosive sublimate in 1 pint alcohol and apply with a soft brush. If it leaves a white precipitate dilute with alcohol until it does not. A correspondent strongly recommends this recipe.

(34) H. L. W. writes: You say apply muriatic acid diluted with 5 or 6 times its quantity of water, and after a minute or two wash with clean water. I have tried it and could not make it work. How shall I apply it so it will? A. The recipe referred to the common—gallo-tannic iron—inks. Inks containing Prussian blue, indigo, logwood, chromium salts, and coal tar dyes are more or less indelible. You may try the following solvents in the order named: Water, alcohol (hot and cold), citric acid, oxalic acid, dilute (pure) muriatic acid, strong muriatic acid, strong water of ammonia, solution of potassium ferrocyanide, strong chlorine water or hydrogen peroxide, solution of potassium cyanide. The liquids are traced on with a glass pen, and after standing a sufficient time, it is covered with warm (dry) tripoli powder (infusorial silica) or pipe clay, which absorbs the liquid or ink solution. 2. You also say a solution of oxalic acid, citric acid, and tartaric acid may be applied where there is printing, as it will not attack the printed text. Do you mean all the acids equally, or either one reduced with water? A. The solid organic acids—citric, tartaric, oxalic, etc.—are dissolved in a small quantity of warm water.

(35) N. L. gives the following method of truing an emery wheel without a diamond: Hold a piece of white chalk against the wheel while in motion. This will show you the high places. Then take a pick of the kind used to dress millstones, or make one of a file about five inches long, wedged in a stick like a miller's pick. Hack the chalked places and keep chalking and hacking, rubbing over with an old file each time before chalking, until the wheel is true and the chalk touches all around.

(36) E. P. O. asks (1) the mode of constructing an electric engine of 3 horse power? A. You will find a description of an electric engine on p. 184 of our issue of September 22, 1877. 2. How many cells of Daniell's battery, also how many plates of Smee's battery, would be required to run the engine so constructed? A. The amount of battery power required will depend on so many details that we cannot give an opinion. 3. What sized wire and how long must I have for helix? A. If you make an engine on a scale six times the size of the cut Fig. 1—then about 30 lbs. of No, 16 copper wire, cotton-covered, would be a good size and quantity to wind on the iron cores, D, and 40 lbs. of No. 12 copper wire, cotton-covered, for the cores A A. Let the width of the engine (as seen by a plan view) be such that the wire may be disposed so as to occupy about the same relative space as it does in the cut.

(37) M. A. N. sends the following problem: A heavy stick of timber is to be carried by three men. One man is to carry one end, and two men are to use a lever at a certain distance from the other end. At what distance from the shorter end must the lever be placed that each man may carry an equal part of the weight, no allowance being made for the weight of the lever? A. Supposing the stick to be uniform in section, the man at the end applies his force at the end of a lever equal to half the length of the stick: and as the other two men apply twice as much force they must apply it at the end of a lever one half as long as the preceding, or at one fourth the length of the stick from the other end.

(38) E. C. N. asks: If I should wind a few feet of wire around a strong magnet, can I get a current of electricity so I could run a relay? The other night while I was testing some electro-magnets I received a very sharp shock by taking up one of the wires of my battery while the other wire was at least 10 feet from me on the brick floor. A. Not unless you open and close the magnetic circuit by means of an armature, or in some way continually disturb the relative position of the magnetic field of the permanent magnet, on which the wire is wound. The shock you received is frequently felt under similar circumstances by the battery men who have the care of a large number of cells, used for the purpose of supplying the telegraphic lines with galvanic electricity.

(39) A correspondent sends a recipe for a gold lacquer for brass: Dissolve in about 12 ozs. alcohol ½ oz. shellac, 1 drachm dragon's blood, and ¼ drachm turmeric root. It is sometimes necessary to filter the varnish. It is applied as usual. At first the varnish will seem to be a failure, but in a short time it will have a beautiful gold color.

(40) J. S. H. asks how to prepare a jet black enamel? A. Black enamel is thus made: Peroxide of manganese 3 parts, zaffre 1 part. Mix and add as required to white enamel, which is: Washed diaphoretic antimony 1 part, fine glass, free from lead, 3 parts. Mix wet, pour into water, powder, melt again, and repeat this three or four times.

(41) W. E. A. incloses a piece of "magic paper," and asks its composition. On being touched with fire it entirely disappears, ashes and all. A. It appears to be nitro-celludin—made directly from a pulp of gun cotton, or converted after coming from the paper machine by digestion for a few minutes in a mixture composed of equal parts of fuming nitric and fuming sulphuric acids, or fuming sulphuric acid mixed with pure dry saltpeter, and washing in water made slightly alkaline with soda. It is a dangerous article to keep in store.

MINERALS, ETC.—Specimens have been received from the following correspondents, and examined, with the results stated:

J. G. P.—No. 1 contains ferric sulphides and a trace of gold—tellurides not present in sample. No. 2 is a quartzite containing magnetic pyrites, but no silver or bismuth. No. 3 will probably prove a rich silver ore—the sample contains argentiferous galenite and a little copper.

COMMUNICATIONS RECEIVED.

The Editor of the SCIENTIFIC AMERICAN acknowledges with much pleasure, the receipt of original papers and contributions upon the following subjects:

On the Progress of Engineering.
On Drawing on the Blackboard.
On Telephonic Communications. By T. F. W.
On the Calendar.
On Golden Relics. By C. F. R.
On the Manufacture of Surface Plates. By O. C. G.

HINTS TO CORRESPONDENTS.

We renew our request that correspondents, in referring to former answers or articles, will be kind enough to name the date of the paper and the page, or the number of the question.

Correspondents whose inquiries fail to appear should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them. The address of the writer should always be given.

Inquiries relating to patents, or to the patentability of inventions, assignments, etc., will not be published here. All such questions, when initials only are given, are thrown into the waste basket, as it would fill half of our paper to print them all; but we generally take pleasure in answering briefly by mail, if the writer's address is given.

WANTS AND BUSINESS INQUIRIES.

Almost any desired information, and that of a business nature especially, can be expeditiously obtained by advertising in the column of "Business and Personal," which is set apart for that purpose subject to the charge mentioned at its head.

We have received this week the following inquiries, particulars, etc., regarding which can probably be elicited from the writers by the insertion of a small advertisement in the column specified, by parties able to supply their wants:

Who makes hand presses for toilet soap?

Who makes musical bells for parlor use, chimed to give notes and half notes?

Who makes machinery for kiln-drying corn?

Who makes surveyor's instruments, graded according to metrical measurement?

Who sells cuca leaves?

OFFICIAL.

INDEX OF INVENTIONS

FOR WHICH

Letters Patent of the United States were Granted in the Week Ending

December 4, 1877,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

A complete copy of any patent in the annexed list, including both the specifications and drawings, will be furnished from this office for one dollar. In ordering, please state the number and date of the patent desired and remit to Munn & Co., 37 Park Row, New York city.

Animal black, artificial, P. G. L. G. Designolle... 197,824
Bale tie, Bull & Koch ... 197,824
Bale tie, W. M. Seaman ... 197,802
Baling cotton, L. Belden ... 197,817
Bee hive, J. N. Becker ... 197,814
Belt fastener, W. Ferguson ... 197,726
Belt shifter, T. N. Egery ... 197,840
Berth for vessels, self-leveling, D. Parks ... 197,886
Binder for letters, etc., H. H. Hall ... 197,776
Blanket case and shelter tent, O. E. Michaelis ... 197,878
Book support, A. Clarke ... 197,763
Boot and shoe, W. W. Whitcomb ... 197,917
Bottle stopper, F. W. Perry ... 197,890
Brake, car, S. Williams ... 197,919
Brake, wagon, A. Hart ... 197,778
Broom, H. M. Jenkins ... 197,855
Buckle and hook, combined, T. L. Wiswell ... 197,808
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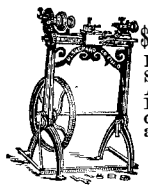

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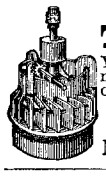

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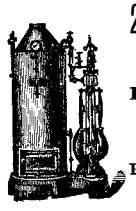

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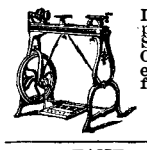

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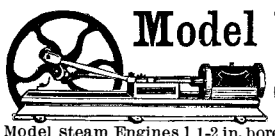

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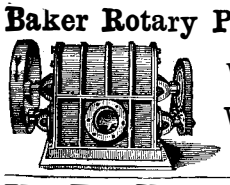

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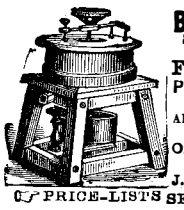

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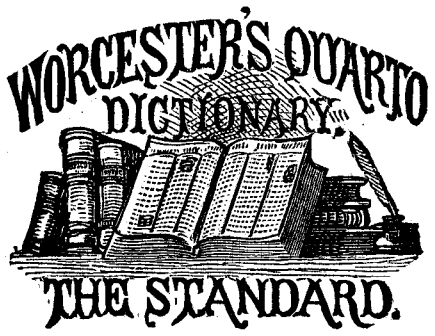

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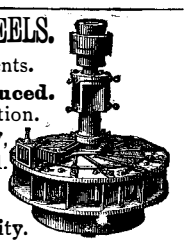

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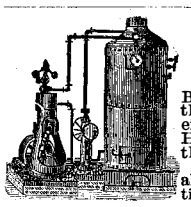

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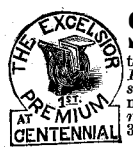

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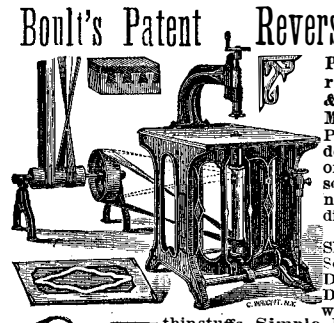

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